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Principal Contents

What is a Consulting Engineer?

PROFESSOR George C. Whipple, of Harvard University, in a recent technical article takes objection to the use of the word "consulting," as applied to the engineering profession. The title of consulting engineer is deemed by Prof. Whipple to be largely a misnomer. Its use by engineering practitioners is so indiscriminate as to be without justification. So changed has the sense of the expression, "consulting engineer," become that to-day its true significance is almost obliterated. "What is a consulting engineer?" asks Prof. Whipple. "Do the words mean the same as they did a generation or two ago? Is an engineer a "consulting engineer" when he is not being consulted? Does the term represent a state of willingness or desire to be consulted, the qualification to advise, or does it describe an actual service and cease to apply when the service has been rendered? Does it signify merely an engineer who maintains an independent office and is free to undertake engineering work for any client who comes? If so, by what other title shall be called the engineer engaged to advise or support a fellow engineer or to review his plans or work in order to assure some client that the plans are sound or the work well done? Is it ethical for an engineer to advertise himself as a consulting engineer, or is the use of the word "consulting" an affectation, an assumed superiority, a self-raised pedestal, a bait to lure the unwary client? Has the noble word "engineer" become so belittled that it is necesary to bolster it up with an adjective not descriptive of a special field of work, but merely indicating that the holder of the title is looking for a job? Or is the change merely a phase of the general movement to raise society by pulling down a higher title, a movement whereby the washwoman becomes a washlady, the music teacher becomes a professor, the plumber becomes a sanitary engineer?"

This stand is quite true, we believe. No protracted investigation is needed to expose the indiscriminate adoption of the expression "consulting engineer." Nearly every engineer and many that are not by any measure or means engineers, have their shingles labelled with this term. The professional cards show that the title is almost universally adopted by private practitioners to-day. In the years gone by, when professional dignity was, perhaps, more characteristic than at the present, engineers who dared to term themselves "consulting," were truly so. Their work was purely advisory. They performed specialized services, by giving advice on plans already prepared or reviewing projects for clients Their duties were analagous to those of the physician called "in consultation" or those of an "advisory counsel." As such, the men for such services were those widely experienced in their profession.

To-day the term has lost its meaning through abuse. It has been adopted by members of the profession whose work may never be advisory. They may prepare plans or supervise construction—work essentially non-advisory—but they cling to the word "consulting." Those whose duties really grade them as consulting engineers in the loftiest sense of this term are few, and their names are conspicuously absent from the published lists of professional cards. "If the term means merely that the engineer is in private practice," says Prof. Whipple, "its true meaning is utterly lost and its use correspondingly unnecessary. If it means that the engineer regards himself as capable of advising or giving consultation, its use is attended with such opportunities for self-aggrandisement that it is undesirable. If it means that the engineer is a specialist in a particular field, its use is not as descriptive as the word specialist, accompanied by a statement of the specialty. Viewed from almost any angle, the use of the word as an assumed title is objectionable and detracts from the dignity of the word 'engineer.'"

This gentleman urges the reservation of the title "consulting engineer," for those whose duties are truly advisory, or as a term to be conferred on engineers during the term of a particular advisory engagement. There is much to be said in favor of this suggestion. Much more can be said now that efforts are being made to enhance the dignity of the profession and develop codes of ethics for its guidance, for nothing lowers professional status more than indiscrimination in the use of the name of the profession.

Comprehensive Report on Street Improvement

THE Department of Public Highways of Ontario has just published a report on street improvement in Ontario, which contains information procured by a survey of 22 cities and 11 towns. The report has been published with a view to assisting the smaller municipalities in the province in the improvement of their streets. A great amount of money has been misspent or wasted, due to lack of experience and proper advice and guidance in the undertaking of schemes for street improvement. It is hoped that this publication may present information which will prevent such mistakes from being repeated.

In the introductory portion of the report Mr. W. A. Maclean, Deputy Minister of Highways, outlines the growth of our city streets from the country corners of several generations ago to the modern urban thoroughfare of to-day. The expenditure involved by street improvement is discussed, and the mistake of undertaking work of this nature, without consideration of a general plan, condemned. Lack of intelligent and experienced supervision also accounts for much of the expenditure of public funds, for which no adequate return is received.

Location to Suit Future Needs

The location of main thoroughfares with the possible growth of the municipality in view, and the proportioning of these highways to suit not only the present but the future need of the community, are phases of the work that demand careful study. The selection of the type of pavement best suited to local conditions is of great importance. There are a number of factors that should govern this selection, the chief of which are: The size and wealth of the municipality; the amount and class of traffic on the street under consideration; the class of street, whether business, residential, etc.; and the materials available locally for use in the construction of road surfaces.

Then follows a discussion of the selection of materials for the different types of construction, covering all classes of pavements, from the gravel or broken stone surface to the most durable, as well as the most expensive forms, such as creosoted wood block, brick, and stone block. These descriptions are illustrated by drawings. Streets of cities, towns, and villages are classified, and the materials best suited to the construction of these are shown under the different headings. The treatment of gravel and macadam roadways with oils and tars is described; the advantage of rounded corners at intersections, in order that motor traffic may turn easily and safely, is illustrated; the paving possible in avoiding land damages by the establishing of permanent grades and street levels in new subdivisions is shown; and the two important items of drainage and foundations are discussed.

Street Improvements in Detail

The second portion of the report describes in detail street improvement in 29 of the municipalities throughout the province. The history of street improvement, from the laying of the first roadway, is given, and the methods used in the construction of pavements, sidewalks, curbs, gutters, street railway track allowances, and pedestrian crossings are described. Detailed costs of materials, labor, pavements, sidewalks, curbs, and gutters are furnished. Special features, such as the construction of bridges, subways, driveways, etc., are fully described, and the costs of these various works supplied where possible.

The last seven pages are devoted to tabulated data, which show the extent of paving in the municipalities, the cost of different classes of pavements prior to 1915, and the cost of the different sections of pavements laid in 1915. This tabulated information is in itself a valuable record of pavement costs prevalent throughout the province.

Canada to Build Wooden Cargo Vessels

THE shipbuilding program in Canada is becoming of extensive proportions. One of the chief factors in the situation is the production of wooden vessels, under the management of the Imperial Munitions Board, who have undertaken to look after the production of vessels in Canada for the British Government The plan is to construct as many vessels as possible, which will be employed in the general cargo carrying business, so as to assist in offsetting the activities of the German submarine.

The Imperial Munitions Board have decided upon a standard wooden vessel, which will require about 1,500,000 feet of lumber for its construction. Its dimensions are as follows:

	Ft.-In.
Length B. P.	250.0
Breadth, extreme	43.6
Breadth, moulded	42.6
Depth, moulded	25.0
Depth, over keel	27.0
Draft for displacement	22.0
Draft over keel	21.0

Deadweight on 20 ft. maximum.
Draft to Lloyds summer freeboard, 2,500 tons approx.
Deadweight on 21 feet maximum draft. 2,800 tons approx.

The vessel is to be of 2,500 tons D.W. The details of hull construction, fastening, etc., are to meet in general with the approval of Lloyds and of the board's technical advisers. The vessels are to be built to Lloyds requirements for A1 classification, and to the requirements of the British Board of Trade as far as necessary for a cargo steamer. The machinery is to be of the single screw, triple type or geared turbines, of 590 I.H.P., with two water-tube boilers of Howden type.

The builders are to deliver ships to the owners after trial, with all classification certificates complete. The trial is to consist of a six-hour sea run at full power, during which machinery must function to the satisfaction of the owner's representative. The builders must guarantee workmanship and material for six months after delivery. Complete specifications and working details can be obtained upon application to the Imperial Munitions Board.

Drastic Fair Wage Clause in Montreal Civic Contracts

The Montreal Board of Control have decided to insert a more drastic fair wage clause in all civic contracts for public works. The contractor will have to agree to a schedule of wages established by the board and to furnish a list of day laborers and workmen in his employ, with the wages paid to each man. The city is, further, to have the right, in the event of the salaries not being up to the city's schedule, to pay the difference in the amounts and to deduct these from all sums due by the city to the contractor.

The Ross Memorial

Half Million Dollar Addition to Montreal Institution Unsurpassed in Equipment and Hospital Architecture by Anything on American Continent—Concrete-Lined Tunnel Constructed Under Difficulties

THE Ross Memorial Pavilion of the Royal Victoria Hospital, Montreal, which has been erected and equipped by Mr. J. K. L. Ross in memory of his father and mother, is the last word in hospital architecture and equipment, being unsurpassed by anything on the American continent. It is beautifully situated on the slopes of Mount Royal, northwest of the main hospital building, with which it is connected by means of a shaft and a tunnel 270 feet long.

The style of architecture is Scotch baronial, carried out in Montreal limestone, with rock-faced surface, in keeping with the other buildings of the hospital. The architects were Messrs. Stevens & Lee, of Toronto, and Mr. Kenneth G. Rea, F.R.I.B.A., Montreal. The construction was superintended by Mr. George Sellar; Mr. H. E. Webster, the superintendent of the hospital, also exercised a close supervision over the building in all its details, and many of the improvements embodied in its erection and equipment were the result of his extensive experience in hospital work. The general contractors were Messrs. E. G. M. Cape & Co., Ltd., the responsibility of the work devolving upon Mr. T. A. Somerville, the vice-president of the company, in the absence of Major Cape, who is in command of a siege battery in France. Messrs. Cape's superintendent on the work was Mr. S. J. Castleman.

Six-Storey Fireproof Construction

The memorial stone was laid by Mrs. J. K. L. Ross, on June 12, 1916, and the building was formally opened on November 2, 1916, by His Royal Highness the Duke of Connaught, this being the last official ceremony in which he took part as Governor-General of Canada.

"The Ross," as it is already familiarly known, consists of six storeys and basement, the main portion being 250 ft. by 50 ft., while there is a wing at each end of 100 ft. by 50 ft., with sun parlors at the southern extremity, and in the centre a tower of magnificent proportions, commanding an unequalled view of the city. The construction of the building throughout is fireproof, the floors being reinforced concrete and steel beams, while the partitions and furring are terra cotta. The roof is slate, laid on gypsum blocks, with furred space between, and the ridges, flashing, and gutters are constructed of copper.

An Imposing Entrance

The main entrance is by means of imposing gates on Pine Avenue, from whence the driveway leads to a terrace fronted by a retaining wall about 40 ft. high, constructed out of rock excavated for the foundations. This rock was also used for backing the face stone of the building and crushed for concrete for the floors, etc. The entrance hall has a black and white marble floor, with Tennessee marble borders and base, and a panelled dado in quartered oak. The walls above are finished in Caen stone, while the panelled ceiling is richly moulded, in contrast to the other plaster work of the building, which is of the plainest description. A neat bronze tablet, surrounded by a frame of Tavernelle marble, recessed in the wall of the vestibule, bears an inscription in raised letters of the origin of the building, while the bronze and oak desk in the centre of the hall supports a lifelike bust of James Ross, the father of the donor. The main office is situated here; also passenger and service elevators leading to the concourse of the tunnel 60 ft. below, and to all of the upper floors of the building.

In the basement, at the north end, is situated the machinery room, in which are located all the controlling valves, the domestic hot water heaters, the watering cooling tanks, and motor-generator set operating the nurses' call system. The elevator machinery is located in a special chamber, cut out of the solid rock, and forming an extension of the elevator shaft.

First Floor Plan

The south half of the first floor is devoted to waiting and consulting rooms, an up-to-date physical therapy department in all its branches, psychopathic rooms, the X-ray department (the walls of which are lead-lined), and the doctors' rest and cloak rooms. The north half is occupied by the nurses' dress and dining-rooms, storage and refrigerator rooms, sewing rooms, a disinfecting suite, and the main kitchen and scullery. The floor of the kitchen is laid in Welsh quarry tile, with terrazzo borders, and the walls are lined with white enamelled brick. The kitchen equipment comprises large gas cooking range, with hood, steam cereal cooker, stock-pot, vegetable cooker, plate-warmers, electric vegetable scraper, and ice cream machine, with ample refrigerator and general storage space.

The second, third, and fourth floors are typical nursing floors—each containing over thirty private rooms, a large central open-air balcony, a sun parlor at the south end and day room at the north end.

Nurses' Call System and General Details

On each floor there is a central nurses' call station in the office of the head nurse, and a branch call station at either end, with medicine cupboards and dispensing sinks. There are two public washrooms on each floor, two utility rooms, a flower room, a well-equipped diet kitchen, and all the necessary linen storage and slop-sink accommodation. The wards vary from single rooms up to complete suites with bedroom, sitting-room, balcony, and separate toilet and wash-room—and there is no room without running water. The floors in the corridors are cork tile, with terrazzo border and base; in the rooms, linoleum on a cement base, while all the service and toilet rooms have either terrazzo or quarry tile floors. All marble and tile work is flush, with rounded corners, and there are no sharp edges or projections anywhere throughout the building. All door frames are metal, also flush, and the doors themselves are of the best hospital type, veneered in oak. Each room has two sets of doors, so as to exclude noise, and the terra cotta partitions are all double for the same reason. The windows consist of two sets of double-hung sash, and are specially constructed to allow of the admission of fresh air without draughts. Fly screens are provided for each window. The corridors are painted in buff, with enamel dado, and the same scheme is carried out in the rooms, the colors being buff, gray, and robin-egg blue. The wash basins (of which there is one in every bedroom) have flush tile panels behind them, with built-in mirrors with porcelain frames. The sitting-rooms of the royal suites have cosy and well-designed fireplaces. Cold storage is provided for each diet kitchen and flower room. The utility rooms, in addition to the usual plumbing fixtures, have Decarie incinerators, built into the walls, for the disposal of waste material. There is a clinical laboratory on each floor. The stairs are metal, with rounded nosings and coved stringers, oak handrail and steel treads covered with linoleum.

The Operating Department

The fifth floor is arranged similarly to the three lower floors, except that the north wing is devoted to the operating suite, which is absolutely complete in every respect. The walls of the two operating rooms are lined from floor to ceiling with Tavernelle marble, while the floors are laid with Tennessee marble tiles. The floor of the sterilizing room is of the same material, and the walls are lined with Pittsford Valley marble. The anaesthetic rooms, cystoscopic room, workrooms, plaster room, and other departments of the operating suite have terrazzo floors and tile walls. Convenient and commodious dressing, wash and rest room accommodation is provided for the doctors. A large pathological laboratory and ample storage for dressings, instruments, etc., also form part of the operating suite. The sixth floor, which is in the nature of an attic, contains the still room, psychopathic suite, and well-appointed dormitories for the maids, and there is also considerable storage space on this floor.

In the space above the ceiling are located the large ventilating ducts, into one of which is connected the individual vent duct from each bedroom and toilet room, while the ventilation of the kitchens and operating suite are on separate systems.

Three large induction fans, situated in the tower, exhaust these ducts to the open air, while an aspirating steam coil is provided to ensure constant ventilation in case the fans should not be running.

Heating By Hot Water

The building is in general heated by means of hot water, the radiators being located under the windows in each room. Water is circulated through the radiators by means of a pump, located in the central power-house, while also supplies the necessary steam for kitchens, sterilizing rooms, etc. There are a few rooms in which steam radiators are installed, such as the operating rooms and the kitchens. In the latter the radiators are of the "Excelsior" pattern, and are located over the windows, with open grilles having shut-off dampers.

The hot water heating system is laid out on the down-feed system, supply mains being run in the attic space and the risers dropping down to the various floors, as required, to feed the radiators. Each side of the building is on a separate main, so that the temperature and flow of water can be adjusted to take care of abnormal outdoor conditions, such as excessive wind, for instance, coming from one direction. Thus the temperature inside the building can be maintained practically constant throughout, although there may be a strong wind blowing on one particular side of the building. The return mains are run in a tunnel space in the basement, and are piped up in the same manner as the supply mains in the attic.

Provision is made for adjusting the flow in each riser, and also for draining out each one, irrespective of any other. Thermometers are also provided on each flow and return main, so that the temperature may be noted and adjustment made as required. The mains coming from the power-house are in duplicate. Expansion of these mains is taken care of by means of special pipe bends, located at the top of the tunnel.

The radiators used are of a special hospital pattern, having no legs, and being supported on brackets bolted into the walls. This arrangement is a very sanitary one, as cleaning below and behind the radiators can be very readily done. Each radiator is provided with a specially-designed sanitary handle, packless radiator valve on the supply end, and a lockshield valve on the return end.

The domestic hot water service is the usual one, heaters being arranged in duplicate in the basement. Circulating pipes are run from the base of each hot water riser. The water and steam piping throughout is covered with 85 per cent. magnesia.

Brine System for Refrigeration

The refrigerators on the various floors are cooled by means of brine coils. The brine is pumped up from the cold storage department in the main building. The brine mains throughout are covered with cork.

There is a special drinking water system installed, distilled water being used for this purpose. Drinking fountains are located on each floor. Water is distilled in the attic of the building, and is cooled by means of a cooling tank (in which there is a brine coil) located in the basement. A circulating pump is installed at this point which ensures a circulation at all times of cool distilled water.

Ventilation on Exhaust Principle

The ventilation is on the exhaust principle, every room in the building being mechanically ventilated. There are three distinct systems, each having its own exhaust fan located in the attic:

1. A system exhausting air from all the private rooms, toilets, etc. The air is withdrawn from the private rooms in general through the clothes closets, an opening being left under each door. The openings into the ducts are of a special design, setting flush with the plaster, and having no raised ornamentation or grilles whatsoever. The wood window sills in the rooms are so arranged as to deflect the air upwards, and the radiators heat the incoming air to the required temperature.

2. A system exhausting air from the kitchens and serveries, the air from these rooms being withdrawn through openings in the hoods over the ranges and equipment. In the main kitchen the air enters through openings located over the windows, in which are installed indirect steam coils. This eliminates any possibility of cold draughts, as the incoming air is thus heated before entering the kitchen.

3. A system exhausting air from the operating rooms and the operating suite. The arrangement of radiators in the operating rooms and the location of the ventilating openings is such as to provide for hot air being carried across the near the ceiling and floor of the room, mixing with the air in the room, and being then withdrawn through openings to the ventilating system located top and bottom in the walls. This arrangement ensures an even temperature throughout the room, and eliminates cold draughts.

The rising flues throughout are constructed of tile, the joints being carefully pointed on both sides. These flues rise up to the attic, where sheet metal collecting ducts are built, connecting the various flues and running back to the fans on the various systems. Clean-out doors are provided on the top of each duct, so that the ducts may be readily cleaned.

On the main exhaust system a steam-heated aspirating coil is installed, so that in the event of there being trouble with the electric power in the building this system may still be operated.

Steam Service

Steam is brought into the building for the various services, such as kitchens, sterilizers, etc., from the main power-house, pressure-reducing valves being used to reduce down to the pressures required for the various services.

The arrangement of the heating and ventilating systems throughout is in accordance with the most modern practice. Simplicity of design is the keynote, consistent with attractiveness and continuity of service. The systems were designed by Mr. R. J. Durley, Montreal.

Concrete Tunnel Connects Buildings

Access to the Ross Memorial Pavilion from the main hospital buildings has been provided by a concrete-lined tunnel, approximately 250 feet in length, driven through rock, and connected by a concourse section to an elevator shaft, sunk in proximity to the centre of the new wing. This work involved the excavation of 1,400 cubic yards of rock. It was the original intention to sink the shaft and drive the tunnel from the shaft end only, thus confining the work to the site of the new building and eliminating the annoyance of carrying on construction alongside the existing hospital.

The shaft, having an area of 231 square feet, was sunk 54.5 feet from the ground level. The excavation of the first 25 feet was accomplished with 2½ in. drills mounted on tripods. After reaching this level, 11 ft. drill columns, with saddles and arms, were substituted for the tripods, and compressed air power replaced steam. Reference to Fig. 1 will show the arrangement

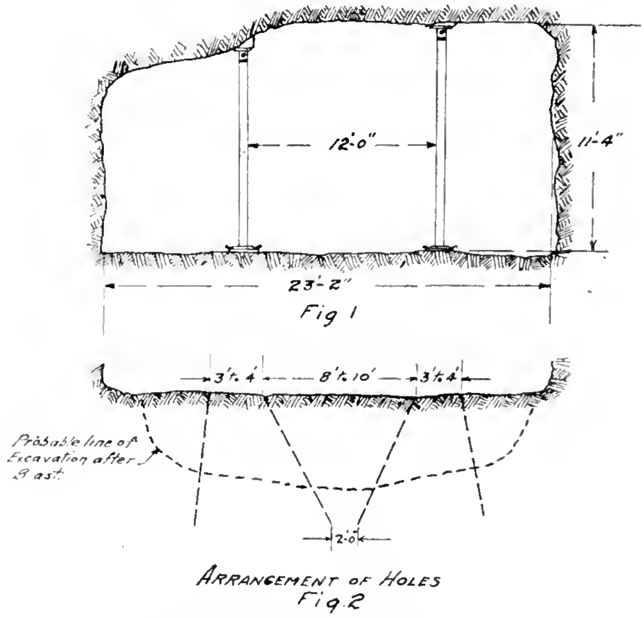


Fig. 1—Arrangement of drill columns in tunnel.
Fig. 2—Four rows of holes were drilled.

of drill columns in the shaft. Working four machines, an average of 18.7 holes 4 feet in depth per shift was maintained, the arrangement of drill holes, of which there were four rows, being as shown in Fig. 2.

Light Blasting Required

The effect on the hospital inmates of the noise and vibration caused by the blasting operations necessitated light blasting and at specified hours, entirely prevented night operations, and greatly hampered any attempts at speed. This shaft was completed in 35 shifts.

The heading through the concourse was started from the shaft, as planned, but, due to the delay enforced by the restrictions placed upon blasting during the shaft excavation, it was recognized that to accomplish the work in accordance with the schedule it would be necessary to push through from both ends of the tunnel. A second shaft was, therefore, sunk to a depth of 15 feet at the lower or hospital end of the tunnel, and operations carried on from both shafts. Only one machine was used on the lower shaft, and it was bottomed in 26 shifts, during which period operations were carried on in the tunnel from the original shaft.

The area of the heading from the elevator shaft was 120 square feet, and progress was made at the rate of approximately 12 cubic yards per shift until further restrictions on the blasting included a reduction in the quantity of explosives used and the number and depths of holes, which greatly hampered the progress and necessitated cutting down the size of the heading, as shown in cross-sections of Sections B and C.

Small Hammer Drills

Small hammer drills of the rotating type were later substituted for the large drills, and a section 6 x 7 was driven through Section C until it was holed through, about 9 cubic yards per day being pulled during this period. In drilling the heading during the period in which the larger machines were used two machines were used at each end, set up on columns. These columns were placed in a vertical position and wedged against the roof of the tunnel. With this arrangement each machine did a row of side holes and a row of cut holes, an average of 9 holes of from 4 to 5 feet in depth being obtained. By shooting the cut holes just prior to the shooting of the side holes it was possible to pull almost the entire 5 feet drilled. Later when the depth of the holes was reduced the same arrangement was used, but each drill was required to put down an additional hole. This method included bench-drilling, as it was found that it could be taken out as well at first, eliminating the necessity of having a drill following the heading machine. When the point was reached where the smaller machines were used, the arrangement of holes was the same, but as the restrictions were placed on the number of holes that could be shot at any one time, the arrangement did not greatly affect the efficiency in operations.

Mucking and Trimming

The size of the heading prevented the use of more than three men on the mucking. The muck was loaded into scale boxes on cars and transported to the shafts, from which they were hoisted to the top and dumped. The size of the heading prevented the use of more than one track in the tunnel, so that the mucking was confined to one car at a time.

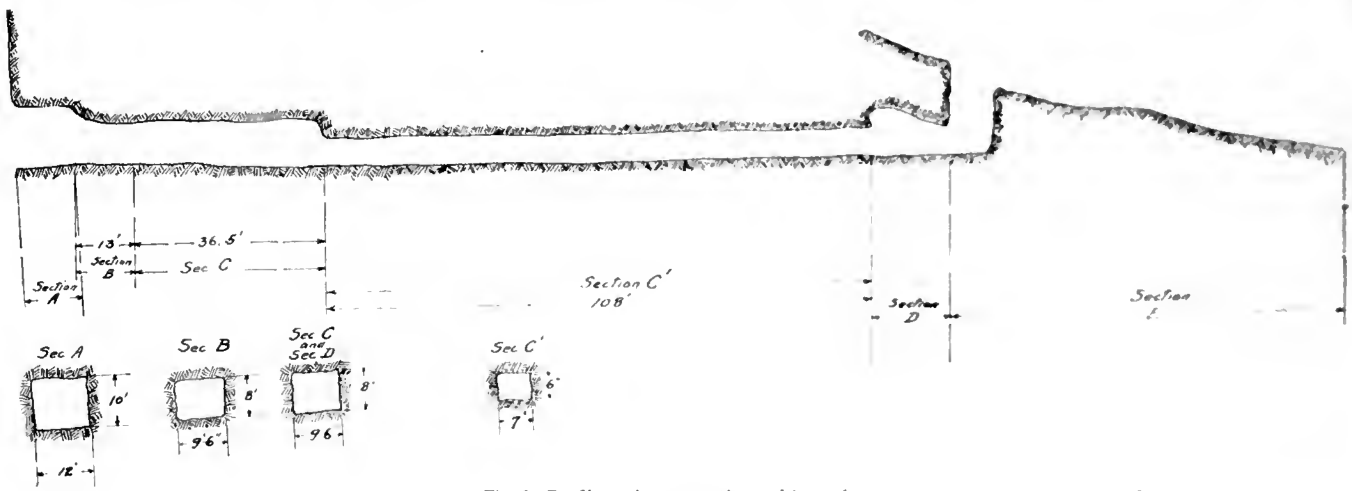


Fig. 3—Profile and cross-sections of tunnel.

As soon as the tunnel heading was holed through, trimming operations were started with the small machines. As it was necessary to trim the heading to a 10 ft. x 10 ft. area, the volume of extra work caused by the reduction of the size of the heading can be appreciated. A trench 1 ft. deep by 3 ft. wide, running the entire length of the tunnel, was excavated with the trimming.

Lined With Concrete

When trimming operations had proceeded far enough to allow, the lining of the tunnel was started, a 1:2:5 mix being used on the side wall and a 1:2:4 mix on the roof. The concrete for the first 95 feet of tunnel was mixed at the top of the large shaft and lowered to the bottom into a hopper, from which it was dumped into wheelbarrows and wheeled to the forms. For the remainder of the work a mixer was set up at the lower or small shaft and wheelbarrows used to convey the concrete. No plums were allowed to be used in the work. The forms were made up in 3 ft. by 12 ft. panels of 1½ in. boards. The panels were set up 3 ft. high for a distance of 48 ft., at which point an expansion joint was placed. The forms were braced against the tunnel every 3 ft., and the wheeling platform was placed on these braces. The rock being uneven along the floor, sand bags were filled and used to choke up all openings, every care being taken along the trench side so that the concrete would not leak through and fill up the trench. Back forms were placed wherever the wall section was over 14 in., and backfill placed as the concreting proceeded. When the first 3 ft. had been filled, the next set of panels was set up against uprights nailed to the outside of the forms already in. These were braced against the rock. Braces were also placed across the top of the uprights, so that the forms were kept from warping. The next 3 ft. was placed board by board, the concrete being shovelled from the wheelbarrows, as in the second 3 ft. At the top a 2 x 4 key was placed to key the roof in. The roof forms were made as follows: 2 x 4's were placed along the side walls, resting on uprights from the ground, or on the top of panels not removed. The tops of these 2 x 4's were 1½ in. under the roof, and by bracing across the tunnel at the bottom of the side braces another 2 x 4 was placed along the centre and braced from the floor. On these three longitudinal 2 x 4's the roof boards were placed, one at a time, as the work proceeded.

Four-inch weep-holes were placed every 4 ft. of the tunnel, running from the roof to the floor, and thence through the wall at the bottom, where the floor rested on 4½ in. cinders. Waterproofing toxin was used in the concrete mixture.

Summary of Work and Equipment

The structural steel of the building was supplied by the Dominion Bridge Company and the ornamental iron work by John Watson & Son Company, of Montreal. The tunnel work was executed by the Foundation Company, under the direction of Mr. C. A. D. Bayley. The firms responsible for the other contracts and supplies were: Roofing and waterproofing, George W. Reed & Co., Ltd., Montreal; millwork and wood finish, also bedroom furniture, George Roberts, Montreal; buff vitrified brick, enamel brick for kitchen, Toxement waterproofing concrete, R.I.W. damp-resisting paint for damp-proofing, cement filler and floor paint for concrete floors, Dartnell, Limited, Montreal; marble terrazzo, and hardware, the James Walker Hardware Company, Ltd., Montreal; refrigerators and cork tile, the Canadian H. W. Johns-Manville Company, Ltd., Montreal; elevators, the Otis-Fensom Elevator Company, Ltd., Montreal; plumbing, heating, and ventilating, the Garth Company, Montreal; fans, B. F. Sturtevant Company of Canada, Ltd., Montreal; sheet metal duct work, McFarlane-Douglass Company, Ltd., Montreal; cut stone, O. Lapierre, Montreal; cork linoleum, the T. Eaton Company, Toronto; fly screens, Watsons, Limited, Toronto; window shades and curtains, George Haysey & Co., Montreal; electric wiring, Canadian Comstock Company, Ltd., Montreal; electric fixtures, McDonald & Willson Company, Ltd., Montreal; kitchen equipment, George E. Sparrow Company, Toronto; sterilizers, etc., Barnstead Still Company, Boston, Mass.

Cost Plus Percentage Scheme with Graded Fees Adopted for U. S. War Contracts

IN connection with the erection of the new army cantonments for the United States army, the war department has decided to let the contracts on a cost plus percentage basis without taking competitive tenders. The steps leading to the adoption of this scheme with the schedule of fees to be allowed are made clear in a U. S. War Department announcement:

In deciding on the cantonment contracts three main points of practically equal importance have had to be considered. The first has been the absolute necessity of speed; the second, proper construction, including sanitation and communication and transportation facilities; the third, economy. Taking all three into consideration, and also the fact that time will not permit the completion of drawings and specifications which would be necessary in order to ask for competitive bids before the work must be started, the Quartermaster Corps, acting in conjunction with the Emergency Construction Committee, decided to make contracts on the percentage, or cost-plus basis, at the same time using all possible safeguards in the shape of guarantees from the contractors as to their capacity and integrity

The profit system has been decided on only after weeks of study to find a basis for the fees which would assure the country of the highest grade of work from the contractors and at the same time prevent extravagance through the payment of excessive profits. It is a pleasure to pay tribute to the loyalty and patriotism of the great majority of contractors who have come here to discuss the question with us. With a few exceptions they have acquiesced willingly in our contention that the profits must be kept down to the lowest level consistent with high-grade work. Some firms have offered to do the work on a cost basis, but we have considered this an unwise policy both economically and nationally. The utmost speed and efficiency must be developed in these and future building jobs for the Government, and the acceptance of offers of free service might easily disrupt the high-grade contracting firms best qualified to do the work effectively.

Steps are being taken by committees also to safeguard the Government from paying unreasonable prices for materials. These committees are mobilizing the resources of materials in the various branches, co-ordinating the supply and demand and fixing prices which will give the material interests a fair, low margin of profit, but with a tendency in all cases to make these prices somewhat lower than the prevailing market rates for each commodity.

The schedule of fees follows:

If the cost of the work is under $100,000 a fee of 10 per cent. of such cost.

If the cost of the work is over $100,000 and under $125,000, a fee of $10,000.

If the cost of the work is over $125,000 and under $250,000, a fee of 8 per cent, of such cost.

If the cost of the work is over $250,000 and under $266,666.67, a fee of $20,000.

If the cost of the work is over $266,666.67 and under $500,000, a fee of 7½ per cent. of such cost.

If the cost of the work is over $500,000 and under $535,714.29, a fee of $37,500.

If the cost of the work is over $533,714.29 and under $3,000,000 a fee of 7 per cent. of such cost.

If the cost of the work is over $3,000,000 and under $3,500,000, a fee of $210,000.

If the cost of the work is over $3,300,000, a fee of 6 per cent. of such cost.

The total fee to the contractor hereunder shall in no event exceed the sum of $250,000, anything in this agreement to the contrary notwithstanding.

Completion of Montreal Aqueduct Probably Postponed Till After the War

IT looks as if the completion of the Montreal aqueduct, concerning which there has been such a lively controversy, will be postponed until after the war. There have already been serious delays, arising out of which claims for about $1,500,000 are made by the contractors, the Cook Construction Company. These will go to arbitration. Mr. J. M. Fairbairn, M.C.S.C.E., assistant chief engineer of the C.P.R., will represent the city; Mr. W. F. Tye, past president of the C.S.C.E., the contractors; and Mr. Aime Geoffrion, K.C., will be the third arbitrator. Controller Cote is willing to agree to the postponement of the work providing that it will not entail fresh claims by the company.

With regard to the hydro-electric development part of the scheme, Mr. Cote favors the adoption of Plan No. 2, recommended by Messrs. H. E. Vautelet, A. St. Laurent, and J. B. McRae in their recent report, and outlined in the Contract Record of May 30. It is proposed to obtain quotations from the power companies for the supply of electricity for pumping purposes for a period of from ten to twenty years, or even forty years. If the cost on this basis is lower than that for power supplied by the city, a contract would be made. At the same time Mr. Cote will ask for authority to go ahead with the preparation of plans for a new power-house, so as to be ready to proceed when normal conditions obtain.

What Street Improvement Involves

Should be Part of a Broad, General Plan of Development which Considers Future Requirements — Introduction to Government Report

By W. A. McLean*

VILLAGES, towns, and cities grow up at the place where roads meet; at the cross-roads, or where highway meets railway, and where railway meets railway or water route; at the focal point of transportation and traffic. The road intersection is the nucleus from which village and city are developed. Roads and streets constitute the primary framework of town growth, and too much importance can scarcely be attached to the road and street in all civic planning and organization.

The supervision of street improvement and maintenance is a function common to all village, town, and city councils. Municipal works and services are many and varied, including water supply, sewers and sewage disposal, health protection and sanitation, parks, fire protection, street cleaning and sprinkling, garbage collection, street railway management, public baths and playgrounds, municipal franchises, bridges, surveys, and town planning, assessment and municipal finance.

Complexity of Municipal Services

The complexity of municipal services is nearly as great for a town as for a city. The city requires large works, but there is proportionately a great amount to spend upon them. Towns require waterworks, sewers, sewage disposal plants, and well-designed streets, but they have to be obtained for a less expenditure—and the greater economy very often demands proportionately greater skill. The planning of a town in all these respects should, as far as practicable, be undertaken as one work, not a series of disconnected sections. Just as a house is now planned with water service, waste-pipes, sewer connections, and electric wiring, considered in connection with foundations, walls, and partitions, so the more nearly a town's services can be dovetailed into the one system will there be less future expense when these are installed. The tearing up of pavements to lay sewers, water, and gas mains is one of the common results of unsystematic methods.

While many municipalities may not be concerned with waterworks, water purification, sewage disposal, electric lighting, power and gas supply, there is no village so small but is concerned in some degree with its public street or streets.

A Broad Scheme of Development

The improvement of streets in a village, town, or city should not be taken up as a series of independent patches, but should conform to a broad, general plan of improvement, in which each unit will have its place, and which will ultimately produce a complete scheme of development for the entire municipality. It is not suggested that street paving in any municipality should be taken up and completed throughout as a continuous work in one or two years. Street improvement in a town or city can rarely be carried out as one work, but is a matter of growth, extending over a period of years; a single street, or even one block at a time. But whatever the rate of construction, it should be in conformity with a broad plan of improvement, to be followed as far as practicable by succeeding councils.

*Deputy Minister of Highways, Ontario.

The aggregate amount spent on streets is very large. The drain is yearly and continuous. Ratepayers, as a rule, do not realize how important is this phase of municipal management from a financial standpoint. In spite of considerable expenditures, numerous municipalities have little to show for the outlay. Fearing criticism, many councils hesitate to obtain the advice of an engineer experienced in this branch of municipal service. Money is spent year after year in half-way measures, in "old ruts," with little or no permanent return. That municipality is fortunate which has to-day secured thoroughly improved streets without having first made a large expenditure, or accumulated a considerable debt with little or nothing of permanent value to show for it. The large debts with which cities and towns are sometimes burdened are due not so much to the assets actually provided as to the ill-advised and half-way measures so often followed, which result only in temporary or partial service, and which are in the end torn up and "scrapped" to give place to the work which should have been done in the beginning.

Indifferent Results

Street improvement is the object of considerable expenditure in many towns and villages. In some cases substantial work has been obtained for the outlay. In others comparative failure has resulted. Some have made an ambitious attempt to construct well-designed streets, with curbs, and metal or pavement from curb to curb. Others have adopted a less expensive design, seeking only a type of road that will prevent impassable conditions of mud in autumn and spring. Others seem to feel that when roadways have been built no further expenditure for repairs is needed, while some approach the matter from the opposite viewpoint, and hope to obtain satisfactory streets by merely dumping stone or gravel in spots where the mud becomes deepest—a more or less habitual scheme of patching.

Estimates of cost are subject to a number of qualifications. One street may, in appearance, when completed, be exactly similar to another, and yet the cost of the work in one case has been twice that of the other. Differences in amount of grading and earth-work may be a reason. A deep ravine, the haulage of earth to widen the roadways, or the moving of earth to straighten the street may account for a considerable sum. The excavation of clay and boulders is more costly than the removal of sand. Length of haul for stone or other materials composing the road will make a marked difference. Wet weather disorganizes the work and adds to the cost, while the rate of wages varies from season to season.

Supervision Is Important

But the most important factor—one which is most commonly ignored—is the efficiency of supervision. The duty of the engineer is to design the work, give lines and levels, prepare plans and specifications, and provide inspection to see that the construction is in accordance with them. Good service in this respect is essential, but is not always a material factor in the cost.

The point at which money is most often lost when the work is carried on by day labor is in neglect to provide a thoroughly competent construction manager, a man experienced in and conversant with, the organization of labor to produce the desired results expeditiously and with the least "lost motion." Under an inferior superintendent men may fritter away their time, teams may work at half their capacity, machinery may be out of order and idle—all tending at times to unnecessarily increase the cost of the work. The management of the work is rarely the duty of the engineer. If a municipal council has not the necessary construction manager at their disposal, the work should be let by tender, throwing the onus of good management upon the contractor, who will work under the supervision of the engineer and an inspector appointed by the engineer.

Street Layout Influences City Development

The manner in which streets are laid out is a determining factor in many details of a city's welfare. Natural advantages of a situation, by poor street location, may be lost or even converted into obstacles; while, on the other hand, apparent obstacles to development, if wisely considered, may be converted into advantages by a suitably arranged street system.

The favorable situation of a business thoroughfare, the accessibility to the residential section, the opportunity for factory and industrial sites, the convenience of railway and shipping facilities, easy drainage, are intimately bound up with the arrangement of streets, which may tend to the congestion of traffic, or may tend to traffic diffusion. A large economy (or waste) of time and money may, for all future, be dependent upon the initial plan of streets.

Motor traffic is making an unprecedented demand upon the carrying capacity of city streets. The number of motor cars in Ontario, for example, is growing rapidly. In 1904 there were registered 535 cars; in 1914, 31,724 cars; in 1915, 42.346 cars; in 1916, 54,375 cars. In 1917 it seems probable that the number may exceed 65.000, and 100,000 cars is a possibility in the not far distant future. This traffic will, proportionately, converge on city streets; and to meet its needs main diagonal thoroughfares will be found a most effective solution. The majority of urban municipalities in Ontario have been subdivided on a rectangular system. Main diagonal thoroughfares shorten distance, save time, and prevent traffic congestion.

Many Cities Have Been Handicapped

The aggregate economy and the diffusion of traffic produced by diagonal thoroughfares render them an important key to the traffic situation of the future. The more important cross or connecting streets may then be laid out as a series of rings; the entire system resembling a spider-web rather than the common "gridiron" plan of streets.

There are few cities of importance which to-day, if it were possible, would not make radical changes in the layout of their streets. Many cities, after laboring under a handicap for years, have been compelled to carry out expensive schemes of street widening and of opening new thoroughfares, to overcome the defects created by neglected growth. The lesson is obvious. Forethought and intelligent planning applied to the street system during the period of growth are fundamental to favorable urban development.

Every town and city desires to grow. Growth is the natural and healthful tendency of a prosperous community. The country road of to-day is the city thoroughfare of to-morrow. The present sparsely occupied suburban area may quickly become the residential annex, or the industrial district, under development of the not far distant future. A city has an immediate interest in the territory over which growth may be anticipated, and in the location of main thoroughfares through that territory. The value of radial roads, the "spider-web" system, applies both to rural and urban conditions. Excellent examples of the former are to be found in war maps of France and Flanders, where main highways radiate naturally from all industrial centres.

Conditions Governing Street Treatment

The general treatment of a street, and the type of pavement to be laid on it, should depend on varying requirements and conditions, such as:

(a) The size and wealth of the town or city.

(b) The amount and class of traffic on the street.

(c) The class of street, whether business, residential, etc.

(d) Local materials available for road construction.

Large cities have greater scope for choice in the matter of pavements than have smaller cities and towns. Wealth is concentrated in large cities, property values are high, and the cost of a pavement is a minor consideration as compared with service. Also, where the amount of paving is great, it is possible to instal extensive plants for laying and maintaining certain kinds of pavements, which are impossible in smaller communities.

Traffic Influences Pavement Selection

The amount and class of traffic on a street is an important factor in the selection of a pavement. While roads and pavements disintegrate to some extent by mere exposure to weather, yet the chief cause of destruction is wear under traffic. Many country roads, particularly the main arteries radiating from important towns and cities, carry much more traffic than some city streets. The number of vehicles passing certain points in large cities is very great; thus a 12-hour census of traffic showed over 3,400 vehicles per hour passing Hyde Park Corner, in London, England. At the other extreme, some side streets of cities do not carry a dozen vehicles per day, and these only private carriages or delivery wagons. The main county roads adjacent to Toronto have shown a traffic of from 500 to 800 vehicles in ten hours. A traffic of from 100 to 200 vehicles per day is more common adjacent to the smaller cities. To the latter traffic main streets of most villages and towns in Ontario may safely be adjusted.

The growing use of heavy motor trucks is creating a new situation with respect to traffic. The frequent passing of light vehicles causes surface wear; but heavy vehicles shatter the road foundations, particularly when used in the spring when snow is melting and frost is leaving the ground; or in the autumn, when the soil is softened after continuous rain. Heavy motor vehicles or heavy vehicles of any kind create a greater need for deep foundations to distribute the wheel load over a greater area of sub-soil.

Class of Street Affects Design

The class of street affects the choice and design of a pavement. In a business section sidewalks are laid to the street line, and the pavement should ordinarily be laid from walk to walk. A pavement is needed which standing horses cannot tear up, and which can be kept clean and free from dust. On a purely residential street the roadway may be narrowed, the sidewalks may be narrow, sod and trees and a quiet pavement are desirable. On a main thoroughfare, carrying traffic to a station or leading to the country, a wider roadway is needed, and one resistant to wear. Some pavements, such as those of granite block or paving brick, are noisy, and are objectionable on residential streets. Some, such as bituminous surfaces or concrete, are more easily kept clean than others, and are, therefore, suitable for retail business blocks; while a limestone macadam, unless oiled, is essentially dusty.

Local Materials Preferable

Local materials should be used as far as practicable, to avoid heavy freight charges and extra cost of handling from the railway cars. Trap-rock is a hard, tough stone for road surfaces, and limestone is soft, susceptible to wear. But it will generally be more economical to use a local limestone, and treat it with oil, rather than to import the more durable trap-rock by rail. In this the amount of traffic is a factor, and, under conditions of heavy traffic, trap-rock may be the cheaper in a term of years. Local deposits of gravel may be used in various ways, commencing with the gravel roadway for light traffic, and, if the gravel is suitable, for heavier traffic, oiling it, treating it with asphalt or tar, or using it in the construction of a concrete pavement. The type of surface can be adapted in many ways to the local materials available.

Railway Terminal Buildings at Squamish, B. C.

VARIOUS substantial buildings for the Pacific Great Eastern Railway Company are now approaching completion at Squamish, the present deep-water terminal on Howe Sound, and distant about twenty-five miles northwest of Vancouver. The contractors in charge are Ledingham & Cooper, Ltd., of Vancouver, who are erecting a large repair shop, storehouse, lavatory building, and concrete foundations for the track scales. The work under way may be described as follows:

Upper—Storehouse at Great Eastern Railway terminals at Squamish, B. C. Lower—The repair shop.

Repair Shop.—Frame structure, 80 x 150 ft., 32 ft. to the eaves. Heavy wooden trusses, 80 ft. long, on substantial columns, resting on large concrete bases, carry the roof; windows are operated from the floor, by means of lever-operating devices. In this building are three massive concrete engine pits, 65 ft. long, supported on piling; connection between these is made by means of wide drop pits, in which are located deep concrete pits for jacks, etc. At the south end of the building are located the tool room and a room for air-brake repairs; over these is the office, size 22 ft. x 32 ft. Three pairs of heavy doors, 14 ft. x 22 ft., in the north end of the building, admit the locomotives and other rolling stock. The roof is of tarred felt, pitch, and gravel, laid under Barrett System specifications. A complete system of drainage conveys all water from the roof and from the pits to the main sewer.

Storehouse.—This structure is 40 ft. x 80 ft., with a platform 20 ft. wide in front and 10 ft. wide at each end, and the building and platform are carried on piles. An office is also located in this building. The roof consists of Johns-Manville asbestos three-ply roofing, and was laid by the Vancouver branch of the firm.

Lavatory.—Size 12 ft. x 13 ft., of the usual railroad type; floor of reinforced concrete. Equipped with hot water boiler, six individual lavatories, and four closets, each having a separate connection with the sewer.

Want Civic Inspection Independent of Province

OWING to a conflict of jurisdiction between the provincial inspector of buildings and the building inspector of Montreal, the heads of the civic departments of fire and police, health, and building have, in a joint report, recommended that the city charter be amended so that the city may make regulations with regard to inspection independently of any provincal laws on the subject. At present the civic by-laws cannot be made more severe than those of the provincial department. It is stated that the latter are inadequate for Montreal, as they do not cover all the cases in the city, and the inspectors of the provincial government are not numerous enough to cover the city and the province. The report, therefore, suggests that the city obtain from the government the power to make regulations suitable for the city's needs. The report further recommends that plans of buildings should be filed with the city building department long enough to permit of their examination and criticism by other departments before a permit is issued. At present the passing of the plans is under the jurisdiction of the building department only. It is also proposed that an extra copy be placed on file.

The late Sir William Macdonald, of Montreal, was one of the nine honorary members of the Canadian Society of Civil Engineers, having been elected in January, 1896. His election was in recognition of his splendid gifts in connection with the advancement of engineering. Sir William gave very generously to McGill University, one of his notable gifts being the engineering and chemistry building. The Society was represented at the funeral.

Losses by Fire Increasing

Data Indicate Growing Seriousness of Fires—Ontario Losses Summarized — 3249 Fires in Four Months

LOSSES by fire in the United States and Canada last month reached the stupendous total of $24,968,000, just $9,000,000 more than the corresponding month of last year. In these figures are included the values of many expensive Canadian factories and industrial concerns.

The losses in the United States and Canada, according to The New York Journal of Commerce, for the first five months of 1917 reach the unusually large aggregate of $127,108,455, as compared with $113,528,920 for the same months in 1916. The following table gives a comparison of the losses for May of this year with those of the two preceding years.

	1915	1916	1917
January	$20,060,600	$ 21,423,350	$ 36,431,770
February	13,081,250	24,770,770	29,587,660
March	18,786,400	38,680,250	17,523,000
April	18,180,350	12,681,050	18,597,225
May	11,388,450	15,973,500	24,968,800
Total 5 months	$81,497,050	$113,528,920	$127,108,455

There were some 261 fires during May, each of which caused an estimated property damage of $10,000 or over. This compares with 244 such fires in April, 270 in March, 381 in February and 303 in January, making a total of 1,459 fires since the first of the year, which caused a loss of $10,000 or over. The May fires classified according to their destructiveness, show the following results:

Estimated Loss	No. of Fires
$ 10,000 to $ 20,000	71
20,000 to 30,000	53
30,000 to 50,000	41
50,000 to 75,000	31
75,000 to 100,000	19
100,000 to 200,000	26
200,000 and over	20
Total	261

Ontario Figures

The summary of fire losses in Ontario during the first four months of the year is as follows:

	No. of fires.	Loss.	Insured Loss.	Non-insured Loss.
January	798	$ 808,419	$ 566,589	$241,830
February	1,020	1,369,139	1,105,039	264,100
March	765	1,144,373	886,126	258,247
April	666	1,201,361	998,384	202,977
Total	3,249	4,523,292	$3,556,138	$967,154

While the aggregate amount of the April loss ($1,201,361) is in excess, it is gratifying that the number of fires in the province in the month of April is less by nearly one hundred than in the preceding month, declares the report of the Ontario Fire Marshal. Unfortunately, the aggregate of the fire loss is due almost entirely to two large fires, both of which are under investigation. In Hastings County, Graham & Company's evaporator at Belleville was burned, involving a loss of about $185,000. In Norfolk County, the loss is almost exclusively caused by the fire in the premises of the Dominion Canners at Simcoe. It has not yet been ascertained what the exact amount of the loss by this fire is, and we are consequently estimating it at the figures furnished in the official Fire Chief's report, namely, $25,000 on the building and $500,000 on the contents. This may be very far astray, but it is the official estimate and when the loss is determined, it will be adjusted in the subsequent month's return.

Garbage Produces Alcohol

Details of Process by Which Alcohol of Satisfactory Quality may be Removed from Garbage at 12 Per Cent. Profit

EXPERIMENTS conducted at the garbage reduction plant of Columbus, O., indicate that alcohol of satisfactory quality can be produced from garbage, according to a report submitted last month to the City Council by Charles P. Hoover, chemist of the city filtration plant, and Thomas D. Banks, superintendent of the garbage plant. The experiments were made with the process patented by Dr. J. J. Morgan, Chicago, Ill., and were carried out at a special experimental plant built by the city and placed in operation last December. The following extracts from the Hoover-Banks report show the methods followed:

The garbage is first weighed, 1,000 lbs. being used in most of the tests, and is then charged into the digestor; from 2 per cent. to 4 per cent. of 60 degs. sulphuric acid is added; the acidulated garbage is then cooked under 60 lb. pressure for two hours; it is then partially neutralized with limestone and discharged into the screw press. The liquor is discharged from the press into the neutralizing tank, and the solids from the press are dried, percolated and made into tankage.

Grease is first separated from liquor and the liquor is then neutralized in the neutralizing tank with caustic or hydrated lime. This neutralization causes quite a precipitate to be formed, which settles to the bottom of the neutralizing tank or sludge compartment. This sludge is drawn off, dried and made into tankage.

The neutralized liquor is cooled by passing through a coil tube surrounded by cold water, and is then discharged into the fermenters. Yeast is then added and the liquor is allowed to ferment for from 36 to 72 hours. When fermentation is complete the liquor is pumped into the fermented liquor storage tank.

Distillation Processes

Distillation is the next step in the process. Cold liquor from the storage tank flows into the tubes of the pre-heater, and is heated by hot alcoholic vapors surrounding the tubes. From the heater the warmed liquor flows to the still itself, entering at a point one-fourth down from the top; here it meets an ascending current of steam, which extracts the alcohol from the liquor. The liquor trickles slowly down from the chamber to chamber, and is finally discharged at the bottom as spent slop. The alcohol, however, rises with the steam through the five rectifying chambers, where its concentration is greatly increased, and passes out of the top of the column to the preheaters, where it is partially cooled and thereby further concentrated and purified. From the heater the alcoholic vapors pass to the condenser, where they are condensed into a liquid and received in suitable containers.

The results of 24 experiments showed that one ton of green garbage yielded on an average of 4.55 gal. of 95 per cent. alcohol, or based on 90 per cent. the average yield was 4.8 gal per ton of green garbage. All calculations are based on this average. The alcohol yields per ton of garbage varied considerably and the results were very irregular. This irregularity is largely ascribed to the great variation of the sugar content of the liquor that is obtained from the garbage.

The following tables from the report show some of the results obtained from experimentation:

Estimated revenue and cost of operation, using present war prices:

Alcohol yield taken at 4.80 gals. 180 degs. proof alcohol per ton of garbage. 20,000 tons of garbage per year.

Revenue.

4.80 gal. alcohol at 75c=$3.36 per ton garbage, or $67,200

Total operating costs, estimated	$40,290.00
Cost per ton garbage	2.01
Cost per gallon alcohol	.42
Profit per ton garbage	1.34
Profit per gallon alcohol	.28
Annual profit	26,910.00

Return on investment, 75 per cent.

Estimated revenue and cost of operation based on average prices prevailing during normal times:

Revenue.

4.80 gal. alcohol at 35c=$1.68 per ton garbage, or $33,600

Total operating costs, estimated	$29,260.00
Cost per ton of garbage	1.463
Cost per gallon alcohol	0.305
Profit per ton garbage	0.217
Profit per gallon alcohol	0.045
Annual profit	4,340.00

Return on investment, 12 per cent.

Effect on Grease Production

A special test was made in order to compare the results of the Morgan alcohol process with the results secured by the regular process in operation at the plant, with respect to the yield of grease and tankage, particularly the latter.

Two portions of garbage, 1,000 lbs. each, were carefully weighed. One sample was treated in accordance with the general practice now followed at the garbage plant and the other sample was treated by the Morgan alcohol process. The yields and analysis of tankage produced are shown as follows:

	Regular Process	Morgan Process
Pounds grease recovered	66.68	62.32
Pounds tankage recovered	164.50	162.00
Gallons of 90 per cent. alcohol recovered		5.80
Analysis of tankage (per cent)—		
Ammonia	3.63	3.26
Potash	2.01	2.16
Tri-calcium phosphate	4.94	1.46
Value grease recovered	$5.01	$4.69
Value tankage recovered	1.76	1.62
Combined value of grease and tankage	6.77	6.31
Value of alcohol at 70 cents gal.		4.06
Total value of all products	$6.77	$10.37

All figures are per ton garbage.

The results shown in the above table indicate that grease and tankage yields are not as high by the Morgan process as by the regular process. Not much dependence, however, states the report, should be placed on the results from this one test, because of the variable nature of the material such as garbage, and the difference found might be accounted for by the method of sampling.

The C. S. C. E.'s New Members

The following have been elected new members, associates, and juniors of the Canadian Society of Civil Engineers:

Members—Mr. Boris Bakhmeteff, special Russian Ambassador to the United States, who has been engaged in extensive hydro-electric work, chairman of the Board of Engineering Investigation, Department of Land Improvement, Petrograd; Mr. H. E. Howe, assistant to the president of Arthur D. Little Ltd., Montreal, directing the work of chemical investigation in Canada; Mr. H. L. Johnson, Vancouver, B.C., divisional engineer C. N. P. Railway at Kamloops, B.C., in charge of construction, etc.

Associate members—Mr. J. W. Calder, city engineer and electrical superintendent, Swift Current, Sask.; Mr. Clifford S. Dewis, of Calgary, Alta., irrigation department, Department of Interior, Calgary; Mr. Nels A. Pearson, Calgary, draughtsman for C. P. R.; Mr. W. M. Stewart, member of firm of Phillips, Stewart and Lea, civil engineers and surveyors, Saskatoon; Mr. A. D. Taylor, St John, N.B., special supervisor in charge of rebuilding three miles of provincial road for Province of New Brunswick; Mr. J. H. Thompson, Radiotelegraph branch, Department of Naval Service, Ottawa.

Junior—Mr. C. L. Archibald, chief engineer Bathurst Lumber Company, N.B., in charge of construction, pulp and paper division.

Transferred from Junior to Associate Member—Mr. A. C. Crepeau, Sherbrooke, in charge of work in connection with development of Two Miles Falls, Weedon, P.Q.; Mr. F. J. Cronk, Montreal, demonstrator and lecturer department of surveying and geodesy, McGill University; Mr. P. E. Jarman, city engineer of Westmount, P.Q.

Transferred from student to associate member—Mr. N. C. Stewart, Vancouver, B.C., in charge of survey parties, Department of Interior, Ottawa.

Transferred from student to junior—Mr. W. H. Hunt, formerly assistant engineer in sewer and water construction, etc., city of Moose Jaw; Mr. W. W. Perrie, Hamilton, in charge of general engineering and surveying for MacKay, MacKay and Webster.

Lime Used for Blasting When Dynamite Was Impracticable

One of the greatest forces produced by chemical action is that which is generated by the swelling of quicklime, or unslaked lime, when it is brought into contact with water. The lime when wet swells with a force that is well-nigh irresistible. Many engineers have worked on methods to make use of this force, but it has never been practically applied until recently. Not long ago it was necessary to tear down a number of stone pillars 20 feet high and 12 feet square, in a factory. Dynamite was impracticable because of nearby machinery. So holes were drilled in the pillars and filled with quicklime upon which water was poured. The mouths of the holes were closed by tamping. In 20 minutes, as the lime swelled, the great pillars split and broke in all directions.

Rejected Material Can Be Profitably Used

Installation of a Crusher to Handle "Oversize" from Small Gravel Plants Pays by Increasing the Marketable Output

SMALL stone crushers are playing an important part in increasing the output of the smaller gravel plants of this country.

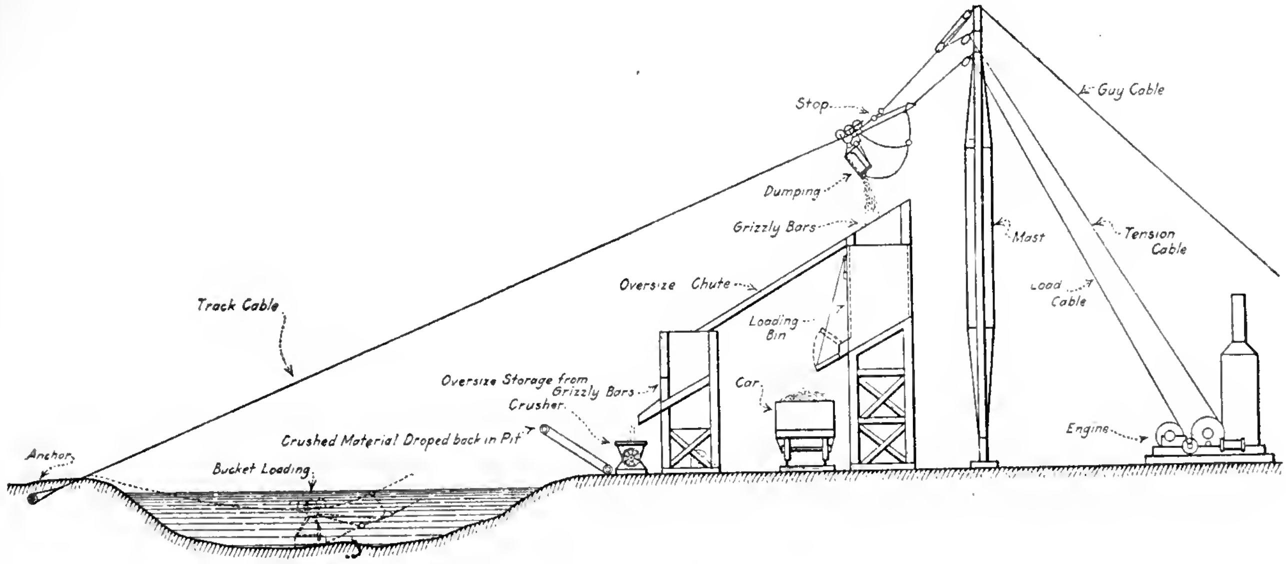
In many cases the installation of a crusher has been an afterthought on the part of the plant owner. It was not in his original plans, but when he found that 5 to 10 per cent. of his gross daily output was oversize gravel the wisdom of putting in equipment to utilize this rejected material was apparent.

Just because the rejected material does not accumulate fast enough to keep a crusher busy continually is no reason why the installation of a crusher should be deemed unprofitable. Our contemporary, Engineering and Contracting, describes some typical plants in which the output has been increased by the utilization of "oversize." Consider the case of a certain small plant which is typical of others that are allowing their oversize gravel to go to waste. The material at this plant is excavated from a river with a dragline cableway excavator which digs and conveys to the screens about 150 yards a day. Of this gross amount about 10 yards a day is rejected by the first gravity screen, and of the remaining 140 yards about one-half is very fine sand, for which there is no market. Thus the net daily production of graded gravel and sand runs about 70 yards. Ten yards of crushed gravel could be added to this output by installing a small crusher and bin with a capacity of 10 yards or so. The bin would hold a day's accumulation of "oversize," and an hour's run of the crusher would reduce all this material to commercial sizes. This plant has had a ready market for more gravel than it can supply, so it would appear as if a crushing outfit would be a wise investment.

Oversize Crusher Pays

There are plants, of course, where the percentage of oversize is not enough to warrant an expenditure for crushing equipment; but even in such plants the character of the material encountered is liable to change at any time, and if the gravel becomes more coarse as the pit goes deeper, a little calculating may disclose that a crusher will pay good returns on the investment.

Such a condition has arisen at an Indiana contractor's gravel plant which has been in operation only a short time. He is digging gravel with a 1-yard Sauerman drag-line cableway excavator. There was only a small percentage of boulders encountered at first, but now the daily gross output of 300 yards is running heavier and heavier to coarse material. An installation of crushing machinery that meets the requirements of this plant is shown in Fig. 1. The "oversize," which formerly tumbled down a wooden chute to a pile at one end of the plant structure, will now pass down a somewhat longer wooden chute to a small wooden storage bin, built with a gate or hopper bottom, to feed into a crusher of about 20 tons an hour capacity, driven by a 20 h.p. motor. This is located at the edge of the pit



Crusher installation that increased marketable gravel output ten to twenty per cent.

and a little to one side of the line of travel of the cableway bucket.

From the crusher a conveyor about 15 ft. long extends out over the pit and feeds the crushed gravel onto a chute which drops the material in the path of the excavator bucket to be elevated and fed to the screens. Bin, crusher, and conveyor are mounted on skids for moving to conform with the frequent changes in the line of operation of the cableway bucket. Thirty minutes' run of the crusher several times a day will crush all the "oversize" material, giving this contractor 20 or 30 yards more of commercial gravel every day, and there is a market for every yard he can produce.

Reclaiming Methods

A similar method of reclaiming the "oversize" is in use at another Indiana plant.

The crusher is a No. 9 Telsmith jaw crusher which has a capacity of about 8 to 10 tons per hour with a 1½ in. crusher opening. The power is furnished by a 25 h.p., 3-phase, 60-cycle, 220-volt, 1,200 r.p.m. A. C. motor. Crushing from 30 to 45 cubic yards of oversize material per day, the average daily cost for current is about $2.50, according to the president of the operating company.

The oversize material rolls off the grizzly bars into a chute, which conveys the material into a hopper elevated above the crusher and about 10 ft. to one side. This receiving hopper holds about 12 yards of material, and the crusher is operated only when the hopper is full. About 30 to 45 minutes are required to empty the hopper, and it is only necessary to operate the crusher three and four times during a day's run of ten hours.

There is a trough, or chute, leading from the receiving hopper over to the crusher, which has a fall of about 3 ft. in 10. By the aid of a hopper gate the operator can control the feed from the receiving hopper into the trough, and the gradual incline of the trough leading from the receiving hopper to the crusher gives the operator an opportunity to sort the material by hand and to throw out any objectionable material before the oversize reaches the crusher. The gravel is dredged out of a flowing stream, and occasionally pieces of wood and other foreign matter are encountered, which the operator sorts out by hand.

Bucket Conveyor Carries Crushed Material

The crushed material is carried from beneath the crusher by a link-belt bucket conveyor. This conveyor sets at an angle of about 60 degrees, and is operated by sprocket chains leading from the main shaft on the crusher. The conveyor deposits the crushed material into an incline trough about 20 ft. above the ground, through which trough the material rolls by gravity back in the river, immediately into the path of the drag line excavator. During the course of a day's run the operator of the drag line can drop his bucket down near the bank and pick up the crushed material at his will and deposit it into the receiving hopper above the gravity washing and screening plant. In this manner the crushed material passes over the screens and is mixed with the screened gravel, making a clean, sharp concrete aggregate.

An economical feature of this installation is the fact that the operator is able to handle the crushed material with his Sauerman drag line cableway excavator and dispenses with an extra conveyor for returning the crushed material to the receiving hopper.

In another small gravel plant the oversize material is crushed by a No. 3 Telsmith primary breaker. The crusher is driven by a belt from the engine which operates the other plant machinery and is equipped with a clutch pulley, so that it is necessary to turn it over only when it is actually working. The "oversize" runs from 6 in. to 2 in. in size, and is reduced to 1¼ in. An 8 yd. hopper is built over the crusher, and the material rejected at the "grizzly" is chuted into the hopper. When the hopper is full, thirty minutes' run of the crusher will empty it, and three or four runs of the crusher a day will take care of all the "oversize."

A Larger Plant System

In a larger plant the storage bin for "oversize" is part of the main timber structure, and has capacity for about 80 yards of material. The crusher is fed by a spout from the storage bin, and the crushed material is then elevated by an enclosed bucket elevator to the washing screens. The crusher is a No. 5 Austin gyratory crusher, capable of crushing 12 in. rock and boulders down to 1½ in. size. Its capacity is 30 tons an hour, and as this far exceeds the amount of "oversize" which will accumulate in an hour, the crusher is only operated intermittently. It is equipped with clutch pulley and operated by rope drive from the engine, which also drives the pump, screens, and elevator.

For intermediate or secondary crushing, disc crushers or large crushing rolls are quite frequently used in the large capacity gravel plants, and where there is a large amount of "oversize" not over 6 in. in size, they can also be profitably employed as primary crushers. In dredging from a river with a centrifugal pump outfit, the Northern Gravel Company, Muscatine, Ia., obtains gravel containing a large amount of "oversize" which is all between 1¾ and 3 in. in size. In this plant a Symons "36" disc crusher reduces the "oversize" to 1 in. size. This is an excellent installation under the circumstances, but it would not be economical for a small capacity plant.

Commercial Aviation on Practical Basis

COMMERCIAL aviation has been a dream of fifty or more years, but here as in so many other directions, the war has applied a stimulus greater than any other force, probably, would have done. In the Engineer (London) there is an outline of recent proceedings that indicate that we are within a quite reasonable distance of the realization of commercial aeronautics. The recent appointment of a committee in England, under the chairmanship of Lord Northcliffe, to enquire into aerial civil communications after the war, brings the whole matter on to a practical basis. Our contemporary gives figures outlined before the Aeronautical Society of Great Britain by Mr. Holt Thomas, who has been very closely associated with aviation since its inception.

The all-important part of the scheme outlined by Mr. Holt Thomas is that of cost, and it is to his figures of costs that engineers will turn their attention. The inducement to go into the question really seriously is the fact that it is known the German States are not only now contemplating arranging air services between themselves, Austria, Bulgaria, and Turkey, but that they have in view air routes throughout the world, as one of the means of building up the German Empire once again. That is a scheme which it is generally admitted must be frustrated, and it was a practical proposition of Mr. Holt's, that as Great Britain and her allies constitute the greater part of the globe, we, in concert with them, should immediately map out international aerial routes, avoiding Germany altogether, but preventing German aeroplanes from traversing over British and allied countries. The claims made for commercial aeronautics are that it is faster than any other means of transport; it is safe, and it is not too costly to provide a commercial proposition. The question of safety was dilated upon, and leaving that to be demonstrated, as, of course, it easily can, to the public by the running of services day after day, we come to actual figures of cost which will be the determining factor as to how soon commercial aerial services can be begun after the war. In the book by Hamel and Turner on "Flying," published some years ago, the costs of running four types of machine were given as 2¼d per mile, 4¾d. per mile, 5½d. per mile, and 3½d. per mile respectively. These figures, of course, refer to peace times so far as cost of petrol is concerned, and also to an old type of machine, with about half the speed attainable at present. With later types of machines, averaging 100 miles an hour, the running costs in the air of three types are as follows:—(a) Carrying a useful load of 1,800 lbs., including petrol and fuel, 6½d. per mile; (b) carrying 1,000 lbs., 5d. per mile; (c) carrying 450 lbs., 2½d. per mile. Applying these costs to an aeroplane service between London and Paris, the total cost of running one machine each way daily, carrying 2,500 lbs. less petrol, oil, and pilot, for, say, 300 miles, is worked out at 4s. 8d. per mile. The cost of the aeroplanes is put at £2,500, but some people doubt whether machines of the type under consideration could be bought at that price. On the other hand, the cost of maintaining landing places, which are suggested at every ten miles, viz., £250 per annum, was regarded as low, and, on the whole, it was agreed that 5s. per mile would work out to be the ultimate cost of one machine each way. The profit and loss account showed that with 12 passengers each way at a charge of £5 per passenger, there would be a profit of £43,000 per annum with four machines in operation; with nine passengers there would be no profit, and with a less number a heavy loss would gradually pile up. Mails were reckoned to be charged at ½d per oz., and with full load, viz., 2,000 lbs., or 32,000 oz., there would be a profit of £60,000 per annum. To Marseilles the charge per passenger suggested is £10, and mails 1d. per oz.; to Constantinople, passenger £25, and mails 2½d. per oz. Running four machines each way between London and Paris, the costs are reckoned at 3s. per mile, and it is on this basis that the rates for passengers and mails are worked out. The average speed, too, is reckoned at 80 miles an hour, quite a low figure compared to the much higher speeds attainable by aircraft.

The above figures give some insight into the manner in which the commercial aspect has been gone into, and agree more or less with the actual results now being obtained in actual aerial services in Italy.

The prospects for the engineering side of aeroplane manufacture after the war are alluring, for the three types of machine now being used for war purposes have each a definite place in civilian flying, with slight modifications. The heavy machine now carrying guns and heavy armament, is regarded as the machine suitable for long distance flights, say to Constantinople; the machine used for ordinary reconnaissance work, photography, etc., may be regarded as the domestic machine, upon which the shorter distances will be travelled; whilst the light scouting aeroplanes will be maintained as a type for sporting purposes, as essential a branch of aviation, if progress is to be made, as racing has been to motor car design and development. Thus it will be seen how important it is that every means should be used to avoid what is a hiatus between the declaration of peace and the commercial need for aircraft output.

The City Council of Chatham, Ont., have sanctioned a grant of $60,000 to the Board of Education for the erection of an addition to the Queen Mary School.

Factors Affecting the Cost of Producing and Purchasing Structural Steel

THE factors affecting the cost of producing and the cost of purchasing structural steel work were discussed in two papers presented recently before the Engineers' Society of Western Pennsylvania. Abstracts of the paper read by Mr. George H. Danforth, structural engineer, Jones & Laughlin Company, follow:

"An item of design in which a high cost is frequently incurred to save a small amount of material is in the use of riveted trusses for roofs and similar places, when a simple beam will answer all purposes, and there are a great many cases where roof trusses are used on spans of 30 to 40, or even 45 feet, where a simple beam would answer all the purposes, weigh possibly a trifle more, but cost in dollars and cents considerably less. This feature is, of course, subject to modifications, due to the variation in the price of material and the price of labor. At the present time it would probably be economical in material, but even at the present time the saving, under these conditions, would not be as great as might be imagined, and the greater stability and ease of cleaning and painting that attaches to the use of a simple beam over that of a roof truss, which has a considerable portion of its surface inaccessible, is plainly evident.

"This idea of getting economy by the use of simple sections in place of complex riveted sections is nothing new. In the days when channels were held at prices of 3c and over, with angles and plates about half this price, it was a common practice to make bridge chords, even of small highway bridges, of four angles, two web plates and a cover plate, in place of two channels, and a cover plate, the conditions in the prevailing prices for material more than offsetting the additional shop work of using the plate and angle section.

"Another item that will occasionally affect costs and also affect delivery is the number of sizes that a designer will put into a structure For instance, there is not sufficient difference between the dimensions of a 6 x 4-inch and a 6 x 3½-inch angle to prevent the use of either size throughout a job, rather than use both sizes. This is also true of 5 x 3½-inch and 5 x 3-inch angles, 3½ x 2½-inch and 3 x 3-inch angles; also 2½ x 2½-inch and 2 x 2½-inch angles. Each size that can be thus eliminated from a job means one less size to be realized before the fabrication of the job can be taken up, and so expedites delivery and reduces the work and troubles in putting through a piece of work.

"In this connection it might be well to mention that even nowadays we occasionally run across work wherein tees have been specified by the designer, in happy ignorance of the fact that there is probably not a more difficult section to get, even under normal mill conditions, than such tees.

"The same is similarly true, although in a lesser degree, of small beams and channels. Many designers use these sections for lintels, when two or three angles could just as well be used, and which would eliminate any necessity for punching or for separators or separator bolts, and with no appreciable increase in weight.

"Going further into detail, you will find the matter of detail design, which of course involves the question of shop drawings. It seems impossible to some people to make details without getting into pockets, where they are very difficult, if not impossible, to drive! or of building up a section which has to be partially assembled and partially riveted before the balance of the section can be put together and the piece finished. There is also a tendency to use an excessive number of rivets. A few excess shop rivets are not serious and do not appreciably increase costs unless the excess is great.

"The contrary, however, is true in regard to field rivets, as we frequently find field rivets put in with a free hand, utterly regardless of what it will cost the erector to drive them. In one instance which occurs to me the designer insisted upon 24 rivets to hold up one end of a 24-inch beam, which was not subject to any excessive load, and very carefully arranged the details so that 18 of these 24 rivets would be down in a pocket where it was impossible to properly back up the rivet in driving.

"Another detail item that seems to receive little attention, outside of drawing rooms that are directly in charge of a shop superintendent, are changes in sizes of holes and in sizes of rivets. This is a frequent item of expense and a constant source of trouble, as, unless everyone connected with a job is constantly on guard, the condition will arise where a member that has been built using ¾-inch rivets will connect with a member that has been built using ⅞-inch rivets, and the holes for the field connections, instead of being the same size, will be of different sizes.

"Column splices constitute another item wherein much money is often uselessly spent. With the ordinary plate and angle columns there is not much need of any splices other than plates on the flanges. An attempt to splice the web also frequently results in bad holes and other difficulties, while a web splice arranged with angles generally serves no useful purpose other than covering up, possibly, a case of a poorly milled end.

"Due attention is rarely given to the economies of duplication. To build one truss is expensive, but to build a large number of duplicate trusses is a relatively cheap operation, and it would frequently be an economy to make a large number of parts of a structure exact duplicates, even though it involved more material than it would to make each separate and individual truss or part specifically designed for its work."

Bonding Strength of Painted Rods

TESTS of painted rods for bonding strength with concrete have been made by the Boston Transit Commission of Boston, Mass. The paints were first given weathering tests and tests for action when in contact with alkali water, acid water, and sea water. The results of these tests were very varied, some of the paints failing badly to pass the weathering tests and the alkali water test, both of which tests should be passed by any paint used by the Commission.

For the bonding test, plain round ¾-in. steel rods were carefully cleaned and cut in 24-inch lengths. After being painted with the requisite coats of paint and allowed to dry for a proper time, the rods were embedded for 11 inches of their length on the long axis of concrete cylinders which were 12 inches long by 6 inches in diameter. The concrete was proportioned by volume 1 part of cement to 2 parts of sand to 3½ parts of broken stone (sized ⅜ in. to 1½ in.). The rods were allowed to set in the concrete blocks, undisturbed for two months. Three rods of each series were then pulled out of the concrete in a testing machine at the Massachusetts Institute of Technology, under the direction of Prof. H. W. Hayward, and the bonding strength of the painted rod with the concrete measured. Some plain, unpainted rods had been buried in cylinders and the bonding strength of the painted rods was found to be much less than for these. The best bonding strength of any of the painted rods was only about 1/5 that of the plain rods. The second best bonding was only about 1/6 that of the plain rods. The other paints gave bonding strengths between 2 per cent. and 10 per cent. of the plain rods.

Bradford, Eng., Recovers Products From Industrial Sewage at Profit

The sewage works of the city of Bradford recover the grease turned into the sewers by many of the wool-washing and scouring establishments and thereby convert into a highly profitable by-product a waste effluent formerly difficult and costly of disposal.

The sales of this recovered grease amounted in 1916 to $389,320, an increase of $92,463 over 1915, owing to the high price now obtainable, which is about $122 per ton; and it is estimated that in 1917 $340,655 will be derived from that source, in addition to $24,332 from the sale of manure or fertilizer made from the precipitated sludge after the grease has been extracted. The municipal expense of maintaining the sewage department has steadily declined in recent years, and it is believed that the enterprise will be self-supporting in 1917.

Samples of the grease and manure were analyzed by government experts, who report that the grease is of great value to the leather-dressing trade and to certain branches of the textile industries. The whole of the waste effluent is not treated for grease recovery because the plant is not adequate; the government urges an increased output. The Food Production Department has enquired about the quantities of manure available at Esholt, which is said by experts to have a high fertilizing value.

Water for Camp or Household Uses Easily Sterilized

Following is a satisfactory method of sterilizing small quantities of water for use in camps and summer cottages that is recommended by public health authorities: Take a level teaspoonful of chloride of lime and rub it up in a teacup with a little water to a thin paste, free from lumps. This should then be made up to a cupful and diluted with three more cupfuls of water and poured into a bottle and tightly corked. This is a stock solution, and will keep for a week if tightly corked. A teaspoonful of this stock solution should be added to each two-gallon pail of drinking water, thoroughly mixed, and allowed to stand for a few minutes. This will give about one-half part of free chlorine to a million parts of water, which will destroy all typhoid and dysentery-producing germs in ten minutes.

Manitoba Public Utilities Report

The Manitoba Public Utilities Commission have just issued their fifth annual report for the year ending November 30, 1916. This report is very complete in respect to matters coming within the Commission's jurisdiction and the various reports of the engineers of the Commission are particularly valuable.

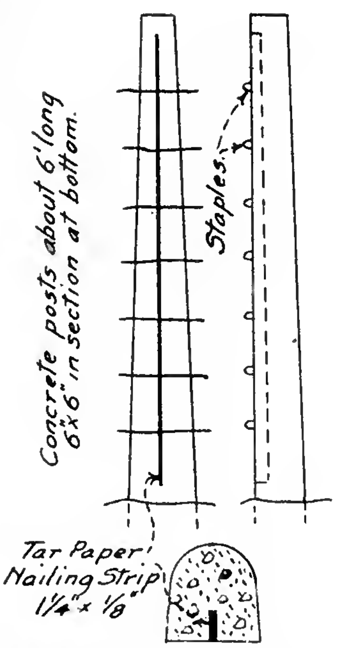
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Tar Paper Insert in Concrete Fence Post Makes Nailing Strip for Wire Fencing

By Fred Mork

THE advantages of concrete fence posts are too well known to be enumerated. One objection, however, to existing types has been the lack of a suitable means of fastening wire fencing to the posts. Hitherto the wires have had to be tied or run through the concrete. The writer has devised a simple scheme whereby fencing may be attached to the post readily, and without injury to either the fencing or the concrete. A hammer is the only tool required, and the wires can be easily fastened with common staples.



Fencing easily nailed to concrete fence posts having tar paper nailing strips.

The writer's scheme is illustrated in the sketch. A strip of tar roofing paper, 1¼ in. wide and ⅛ in. thick, is inserted in the face of the post, extending from about 2 ft. from the bottom of the post to within 4 in. of the top. The tar paper is an ideal medium for this purpose, as it does not expand so as to crack the concrete in the first stage of setting, and remains seated in its bed without contraction. The weather will not rot the material, and it is not injured by the insertion of staples.

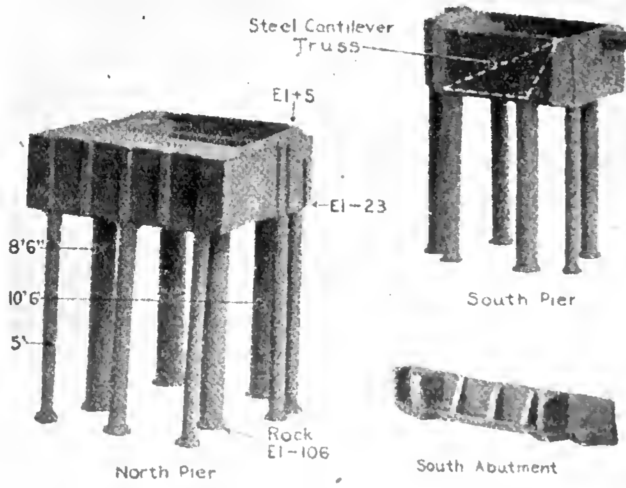
The writer finds that one barrel, or four sacks, of cement will make about 26 posts, one yard of sand or gravel will make about 40 posts, and two men can make 20 posts per hour. The cost is accordingly: For cement, 8½c; labor, 3½c; reinforcing, 5c; total, 17c. This total cost will vary from 14 to 20 cents apiece, according to the materials' market.

Small Scale Models of Complicated Bridge Piers Have Many Uses

A NEW idea for contractors is contained in the method recently adopted by the Great Lakes Dredge and Dock Company in connection with piers for a Chicago bridge. Scale models of the piers were developed which were found to help in the erection and give the field force a visual idea of the whole scheme before and during the work. The many uses of such models are described in Engineering News-Record:—

The piers are unsymmetrically shaped boxes of reinforced concrete, supported on concrete cylinder piers sunk to rock at a depth of about 106 feet. The north pier is about 90 x 80 ft., and the south pier about 80 x 34 ft. Owing to the existence of tunnels, one corner of the south pier has to be left without direct support from beneath and is carried therefrom by a heavy steel cantilever truss embedded in the front wall, as indicated by dotted lines On an enlarged photograph of the models the tunnels are drawn, and various dimensions and elevations are marked. This photograph, 30 x 40 in., is practically an isometric view on a scale of about ⅛ in. to the foot.

The models are on a scale of 20 ft. to the inch. This is the same scale as the general plan of the bridge, so that by placing the models on the plant the relative positions of the wells, piers and adjacent structures are readily shown. The models of the piers were made from old cigar boxes and heavy pasteboard. The shafts are of wood, turned in a lathe to proper size, with a bead to show the belling at the bottom of the shafts. The south land abutment was modeled in clay, owing to the intricacies of its construction. This abutment will be carried by 112 piles. The hole in the bottom, at the right, represents a 7-ft. sewer.



Contractor uses mode s of concrete piers to advantage.

These models illustrate the outside lines of the concrete and the general idea to be followed out in building forms, placing reinforcement and pouring concrete. They serve also to impress upon the men in charge of the sinking the relative sizes and positions of the piers. In addition to the primary purpose already noted, other ideas have followed, and the men in the office are using these models for such purposes as laying out cofferdam plans and working up progress charts.

The primary idea of the models is the more important, especially impressing upon the carpenters and form builders such matters as the form and number of counterforts in walls and also the shape and details, as well as the relative elevations and lines, on all the concrete work. Thus, the study of models by the form carpenters may easily result in avoiding mistakes that are apt to occur in building forms for complicated concrete structures or detail parts.

On account of the south pier being intersected by two large tunnels the study of the model of this pier has solved questions arising in the minds of the foremen and others.

The models have served more than the purpose that was in view when they were made It is the opinion that the planning of work for this bridge substructure has been covered, on account of the use of these models, in a more comprehensive manner than that for any of the bridges which the company has constructed; and it is proposed to use such models extensively in the future. It is interesting to mention also that these models are constructed to the same scale (1 in. = 20 ft.) as that of the company's models of its working plant. This fact enables models of derricks, piledrivers, etc., to be laid alongside the models of the structures, showing their relative size and the extent to which the navigable channel would be obstructed by the plant.

Sand and Gravel Screening Plant for Big Job

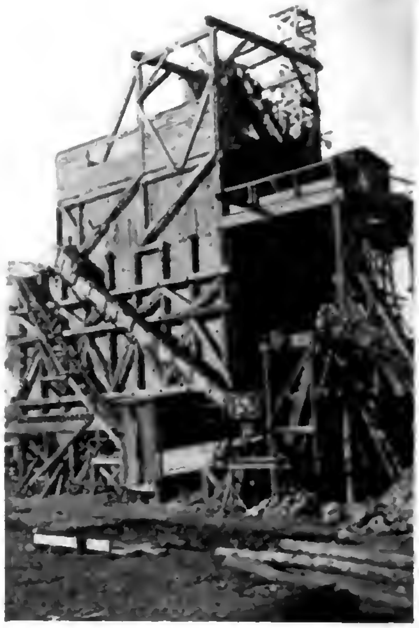
THE Wisconsin-Minnesota Light and Power Company are having constructed on the Chippewa River, in the vicinity of Chippewa Falls, Wis., a dam and power-house, which, when completed, will be one of the largest in that part of the country, its ultimate development to be 45,000 horsepower.

The dam and spillway sections are of the hollow type, constructed of reinforced concrete, and require about 60,000 cubic yards of concrete. The core wall in the embankment, with appurtenant structures, required about 12,000 cubic yards additional. This amount of concrete called for the production of approximately 65,000 cubic yards of gravel and 33,000 cubic yards of screened sand. The contract for furnishing the major portion of this material was carried out by A. Guthrie & Co., Inc., of St. Paul, Minn., who also were the contractors for the entire foundation excavation, both rock and earth; the placing of approximately 600,000 cubic yards of earth in the embankment, and the construction of the reinforced concrete core wall.

The screening and crushing plant shown in the illustration has produced over 50,000 cubic yards of gravel The material was brought to the plant by means of 36-inch gauge steam dinkeys, pulling six to eight 4-yard cars to a trip, the cars being loaded at the pit with a Marion Model 61 steam shovel. The average length of haul from shovel to plant was approximately three-fifths of a mile.

Two complete screen frames were installed, each one being equipped with two screens. For the greater part of the work only two sizes of screen 2-inch and 5/8-inch were used. The screen frames and screens were furnished by the Excavating and Screening Machinery Company, of Minneapolis, Minn. The crusher and elevating equipment were supplied by the Allis-Chalmers Company. The motive power for the entire plant was obtained from electric motors. Storage bins, with a capacity of 300 cubic yards, were provided for both sand and gravel.

The pit from which the material came ran low in percentage of gravel, the average for the season's run being but 26 per cent. This necessitated the handling of an immense yardage of raw material to produce the required gravel. Running two shifts per day, the plant produced 12,000 to 15,000 cubic yards of gravel per month.



Screening plant which produced 12000 cu. yds of gravel per month.

Sodium Hydroxide in Boiler Feed Water Conducive to Failure

The Engineering Experiment Station of the University of Illinois in its Bulletin No. 94, by S. W. Parr, entitled "The Embrittling Action of Sodium Hydroxide on Soft Steel," outlines investigations made to determine the embrittling effect of certain chemicals brought into contact with iron and steel in such a manner as to set up a chemical re-action. These experiments were instituted as a result of boiler failures due to water containing sodium hydroxide. These failures usually show in the form of fine cracks which develop and may proceed from rivet holes to surrounding plate or from hole to hole. It was found that sodium hydroxide in the water made the metal brittle and prevented it from withstanding pressure and changes of temperature. Among the remedies suggested is the neutralization of the alkali in the water with a salt, in such a way as to prevent chemical action on the metal.

The Vancouver Creosoting Company, Ltd., on May 21 removed its offices from 1304 Standard Bank Building, Vancouver, to its plant at North Vancouver.

Modern Conduit Construction

As Exemplified by Recent Extensions on the Toronto Hydro-Electric System

The Toronto Hydro-Electric System recently completed two and one-half miles of underground conduit, connecting up the new plant of the Imperial Munitions Board, Ashbridge's Bay, with the Strachan Avenue sub-station. The new conduits are on King Street, between John Street and Spadina Avenue, and on Wellington, from Strachan Avenue to Bay Street, and Jarvis Street to Cherry Street. The work was started on February 22 and completed on May 1. So far as we know, this is a record for conduit construction, as the average exceeded the placing of 10,000 duct feet per day, or approximately 500 feet of trench excavation, conduits installed and trenches refilled. This is all the more remarkable considering that at the time the work was commenced there was four feet of frost in the ground in certain places. A considerable amount of frost was taken out of the ground by building fires along the line of trenches.

The conduit system consists of a 24-duct run. On King Street clay conduit is used, and 4-inch fibre on the balance of the work. One of the illustrations (Fig. 1) herewith shows

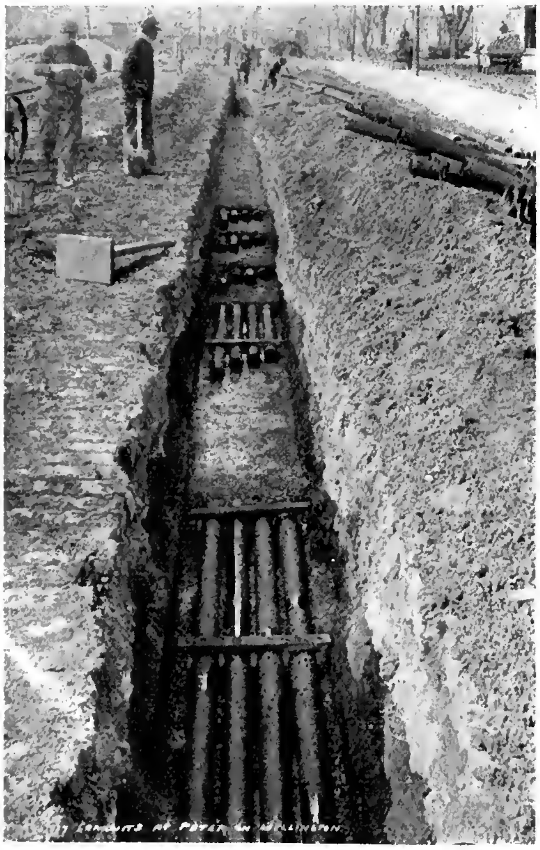


Fig. 1—24-4" fibre duct, 1¼" spacing between ducts.

the installation under way. The ducts are placed in six layers of four ducts each, each duct being separated by 1½ inches of 1:2:4 concrete. This same figure (Fig. 1) shows the combs used to properly space the conduit and to serve as guides for the depth of concrete covering each horizontal layer. In the manufacture of the concrete good sand was not available, so fine crushed stone dust was used for this purpose, with highly satisfactory results.

Unusual obstacles were met with in this work from other underground installations. For example, at one corner—John and Wellington Streets—four manholes had to be constructed, owing to the large amount of obstruction met with. This corner is shown in one of our illustrations (Fig. 2), where two manholes are seen—one showing the ducts in a 4 x 6 arrangement; the other in a 6 x 4 arrangement, the

Fig. 2—Two man holes necessary on account of obstacles.

difference in grade indicating the height of the obstacle that had to be overcome. At different times it was necessary to make considerable offsets, which were frequently accomplished by varying the shape of manhole, as shown in our illustration (Fig. 3).

Brick manholes were built throughout, as being more easily and safely constructed at the time of year this work was undertaken.

The work of installation was carried through by G. M.

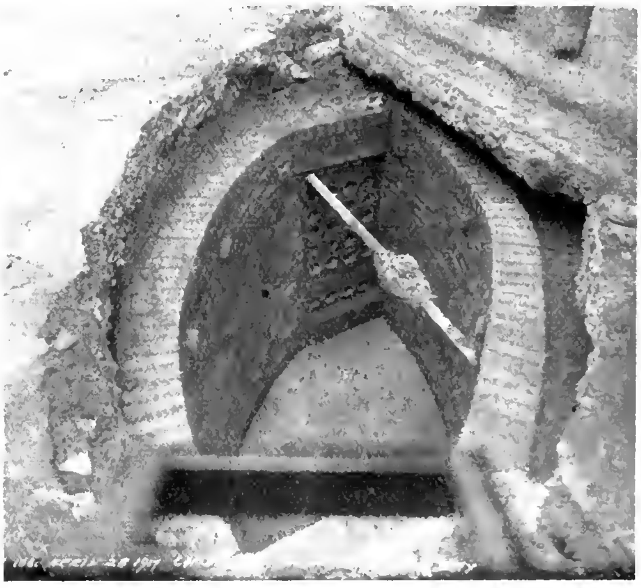


Fig. 3 Offset manhole changing course 4 ft. to right.

Gest, Ltd.; the conduit was supplied by the Fibre Conduit Company, Orangeburg, N.Y.; cable by the Eugene F. Phillips Electrical Works, and concrete material by the Rogers Supply Company.

Mainly Constructional

East and West—From Coast to Coast

At the June session of the council of Bruce County, Ont., it was unanimously decided to adopt a good roads system. The plans outlined show four hundred miles of good roads, including the byways.

The council of Ontario County have decided to adopt a good roads system in accordance with the scheme of the Ontario Highways Department, whereby they will receive government assistance.

The Toronto board of control is submitting a by-law to the city council to authorize the raising of another $4,000,000 for harbor improvement works, and $720,000 for the civic Hydro system, to provide for extensions, etc.

The council of Dufferin County, Ont., have decided to adopt a good roads scheme under the Ontario Highways Act. The necessary by-law has been given the first and second readings, but its final passage has been deferred until the November session, so that the various routes may be determined in the meantime.

The York County Highways Commission, following a conference with the council of Markham Township, Ont., and the residents of the district, have practically decided to go ahead with the work of straightening the road and building of a bridge over the stream at Locust Holl. The new bridge will be between 80 and 100 feet long and from 15 to 20 feet high.

An agreement has been reached between the city of Toronto and the C. P. R., which provides that the company shall construct a reinforced concrete viaduct over the Reservoir Ravine, as part of its scheme for the double-tracking of the North Toronto lines. Beneath this structure, or at a point east of the ravine, to be selected by the city, a subway will be constructed, at the joint expense of the city and the company. When the work is completed the crossings at Summerhill and Maclennan avenues will be closed.

The council of Port Credit, Ont., is considering the widening of the pavement along the Lake Shore Road through the village. There is at present the 24-foot concrete pavement laid by the Toronto-Hamilton Highway Commission and the village plans to extend this the full width of the road, including the construction of curbs and sidewalks. The entire expense will be borne by the Port Credit ratepayers, but a committee will consult the Highway Commission as to the probable cost and if arrangements can be made whereby the amount can be spread over twenty years.

Preliminary to building four of the wooden steamers ordered by the Imperial Munitions Board, the New Westminster Construction and Engineering Company, a recently incorporated company, is clearing the site for its shipyard on Poplar Island. Plans have been drawn for a bridge to connect the island with the mainland, running across the shallow channel from the foot of Third Ave., New Westminster. It will be a 46-foot pile structure, giving a 16-foot clearance above the water. Arrangements are also under way for piling a wharf for landing timbers and other material. The vessels which will be built will be 250 ft. long by 44 ft. beam, and will each contain over 1,500,000 feet of lumber.

Work on the new water-mains north of St. Clair Avenue, Toronto, is to start at once. The contracts have been let to R. E. Huffman & Co. and Mitchell & Moham. The former firm will lay the 24 in. pipes in that section from Duplex Avenue immediately west of Yonge Street to Dufferin Street, along Eglinton Avenue, and also in the Runnymede, Baby Point, and Swansea districts, while the latter will place the 12-in. pipes in Oakwood, Vaughan Road, and the Weston Road. The work is to be carried out this year, with the exception of laying a 16-in. main on Eglinton Avenue, between Dufferin Street and Weston Road. As soon as the mains are completed 6-in. feeders will be laid on the various sections petitioning for them. For the work of digging the trenches Huffman & Co. purpose using two ditch-digging machines, and thus expect to save time and counteract the labor shortage.

Mr. Justice Tellier, in a judgment rendered recently, in the Supreme Court, condemned Treffle Guilbault, contractor, to pay to Marie Boucier, a sum of $294, and the costs of the action, the court applying in this case the law contained in Article 1688 of the Civil Code, as follows: "If a building perish in whole or in part within ten years from a defect in construction, or even from the unfavorable nature of the ground, the architect superintending the building and the builder are jointly and severally responsible for the loss." In 1910 Guilbault constructed two stores and dwellings on St. Hubert Street. In 1913 plaintiff in the present action purchased the property and found there were vices in the construction work which she alleged depreciated the value of the property by $1,000, but for the purposes of her action against defendant, the builder, she placed the amount at $650. She said she had served on him a protest to make good the defects, but he failed to do so. Justice Tellier said the evidence had shown that the defects in the building were the fault of the defendant who must make good the loss suffered by plaintiff. The court estimated the damage at $294.50.

Personals

Mr. Walter J. Francis has been elected president of the Montreal Rotary Club.

T. E. Ryder, formerly manager of the St. John Branch of the Canadian Fairbanks-Morse Company, Limited, has recently been promoted from the rank of lieutenant to that of captain. Capt. Ryder has also been awarded the Military Cross and has been mentioned in despatches on more than one occasion.

Lieut.-Col. J. S. Dennis, president of the Canadian Society of Civil Engineers, is assisting the British-Canadian recruiting mission in the United States for the purpose of securing British and Canadian recruits in that country. He has taken over the western portion of the United States, with headquarters at Chicago.

Mr. Boris Bakhemeteff, the Russian Ambassador on a special mission to the United States, has been elected a member of the Canadian Society of Civil Engineers. He has had a considerable experience in railway and hydro-electric work. Born at Tiflis in 1880, he was educated at the Institute of Engineers of Ways of Communication, Petrograd. After doing work on the Transcaucasian Railway and Simplon Tunnel, he was appointed resident engineer of the power development at Pockamox. He was also engaged in the New York Canal Barge office, and with Mr. John Bogart, consulting engineer, New York. From 1907 to 1914 Mr. Bakhmeteff was in charge of the design and general supervision of construction of several power development plants, and since 1912 has been Professor of Hydraulics and Hydraulical Engineering, Polytechnical Institute to Emperor Peter the Great, Petrograd. In 1913 he was appointed chairman of the Board of Engineering Investigation, Department of Land Improvement, Ministry of Agriculture, and vice-president, Department of Land Amelioration, Imperial Technical Society. He recently visited Canada in connection with hydro-electric propositions.

ESTABLISHED 1886

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Principal Contents

A Car Saved is a Car Gained

THE coal shortage in Ontario and Quebec during the past winter and, indeed, still existing, was due entirely to a freight-car shortage. Probably never before was a lack of rolling-stock so strongly emphasized or so acutely felt. To-day all over the continent, the car situation still presents serious aspects, and is causing no end of complaints from every quarter. From all districts come reports that materials of one sort or another cannot be handled or delivered simply because cars are not to be had. The causes of the difficulty are not due to any one event, but to conditions operating over a number of years. No doubt the time of depression immediately preceding the war was not conducive to the expenditure of any considerable amounts in increasing available rolling-stock. The lack of capital, too, on the part of many of the railroads forbade the building of cars. War conditions, however, suddenly produced an unprecedented traffic, for which the companies were hardly prepared. No absolute relief seems to be in view. There are certain measures, however, that may bring about a moderation of the trouble and provide a partial remedy, at least, and in securing which the public must co-operate.

* * *

The increase of the available rolling-stock by the building of more cars, while naturally the first suggestion, can hardly accomplish a great deal towards relieving complications immediately, and it is immediate relief that is necessary. Additional locomotives and cars are undoubtedly needed, but under no circumstances could they be supplied in quantity for many months. The scarcity of labor in the car shops adds to the difficulty. The railways are co-operating in arranging a distribution of the cars to afford the most equitable results. The shortage so affects their mutual interests that they are sparing no pains, we believe, to secure speedy and efficacious remedies.

Embargoes of certain classes of freight, while affording a certain measure of relief for the time being by releasing cars for more imperative duties, must be considered as purely temporary. Long-time restraints are not desirable and should not be necessary. A certain advantage is being gained in the matter of releasing locomotives for freight hauling and making available greater yard trackage, by the curtailment of unnecessary and overlapping passenger service and the withdrawal of non-essential, luxurious accommodation. The greatest measures of relief are possible, we believe, only through efforts of the public on whom much responsibility rests for better freight service. To get the public to understand what their duty and opportunity are, will require an enlightening, educative campaign, which is precisely what the railways are doing.

* * *

Better loading affords a satisfactory remedy and is one in which consignees of freight can well help. In the Contract Record of May 2, page 388, it was pointed out that much more tonnage could be handled with the existing locomotive power and terminal facilities if cars were loaded to capacity instead of being so often only two-thirds or half full. Many types of freight, in fact, can be loaded to the permissible capacity of 10 per cent. in excess of the stencilled capacity. It is quite evident, therefore, that better loading affords an easy way of increasing available car stock. For all railways in Canada, the average car capacity has increased in eight years by 5.8 tons, while the average load has increased by only three tons. Nearly fifty per cent. of the additional capacity was thus not made use of. To illustrate what may be gained by more economical loading arrangements, one of the railway companies points out that, if the average car load is increased by but five tons over that of 1915, the result is equivalent to the placing of 54,800 additional cars in service, 482 extra freight and yard locomotives, 415 additional miles of yard trackage and a 13.5 per cent. increase in man power employed in train and yard service. This railway company, in submitting these facts, compares a typical train of twenty-three cars in 1915 with the proposed typical train of twenty cars this year, which train differs in having the average load increased as indicated. The result is that 45 tons more can be carried in three cars less.

One more matter in which the public can co-operate with the railways is to speed up the loading and unloading of cars. Complaints are heard frequently that a great deal of rolling-stock is always out of commission by being held up on sidings waiting the transfer of the contents. The public must be educated to release cars as soon as possible that these may serve further demands.

In these matters of better and quicker loading, the public has opportunity of assisting in relieving a complex situation, which no loyal citizen can neglect. Inasmuch as the demands of war commerce are taxing the railways' facilities and there is no immediate prospect of relief by adding cars or locomotives in quantity, surely all will co-operate to relieve the existing rolling stock and make it available for greater service.

Canadian Portable Houses in France

DURING a discussion in the House of Commons recently, Sir Geo. E. Foster, Minister of Trade and Commerce, replying to a question about ready-built houses for France, said: —"The matter was brought to my attention, and I took it up with the department and had the woodworkers plan certain houses. After these plans were made it was thought better—and under my advice it was done—to send the plans to Paris to have them thoroughly looked into and vised, as it were, by governmental authority, acting either directly or through a committee. That was done, and we received modified plans from them for two or three different styles of what we would call shacks, to be used temporarily until more permanent buildings could be erected. In every case their plan called for a more elaborate and more costly building than we had planned. Our buildings would cost from $75 to $100, but with the improvements, coverings, and the like of that, suggested by the French authorities, they would cost considerably more. However, a number of houses were constructed and I got transport for them free of charge to Paris, where they were on exhibition in the Champs Elysees. I myself saw them when I was over there last summer. They had the name of Canada on them, and served to show not only our plan of construction for temporary buildings of this kind, but our materials as well, and they were seen by a great many people. But the war has gone on much longer than anybody thought it would, and although we know now what they want and though the plans are in the hands of the woodworkers of Canada, not much is being done at present. They, too, I suppose, are awaiting the proper time. What works directly against them is the absolute impossibility of getting transport for goods."

Further Details of U. S. Army Camp Contracts

WITH further reference to the contract arrangements made by the United States Government with contractors on the new army cantonments, as mentioned in our issue of July 4, page 577, the following additional details of the scheme might be stated.

The government's interests are safeguarded by a clause permitting its representatives to terminate the contract at will. As there are no restrictions in the agreement which are considered likely to hamper the contractor it is not expected that there will be any serious difference of opinion between the government and any of the firms chosen for the work.

The most interesting feature of the form of contract are those governing the financial relations between the government and the contractor. The latter is to be paid his expenses and a percentage of their total amount, out of which he must meet his overhead costs. The contractor's profit will come in the difference between this percentage and overhead expenses. The maximum amount on any contract is fixed at $250,000.

The government promises to reimburse the contractor on the following items for which he makes an outlay:

1. All labor, materials, and machinery necessary for the work. No departure from the standard rate of wages in the locality may be made without the consent of the government's representatives.

2. All sub-contracts.

3. Rental for construction equipment hired or owned by the contractor at rates fixed in detail on the contract. The rates may be judged from the daily rental of $5 permitted for the use of an automobile.

4. Transporting, setting up and dismantling such equipment.

5. Transportation of field forces engaged in the work.

6. Salaries of resident engineers, superintendents, timekeepers, foremen or other men in the contractor's field office.

7. Buildings, field office supplies, equipment, commissary department, and hospital expenses required during construction.

8. Insurance and bonding expenses, uninsured losses and expenses incidental to the work and approved by the government's representatives.

9. Fees, deposits, royalties and similar necessary expenses.

10. Transportation, traveling and hotel expenses of contractor's employees actually incurred in the work.

The government has endeavored to give the maximum amount of flexibility to the contract in order that all low rates accessible to the government in the matter of materials and other items of expenditures may be utilized. For instance, the government may pay any or all freight charges incurred in obtaining material and machinery; which would tend to reduce the amount on which it must pay a percentage to the contractor.

The contractor is to furnish a bond of $250,000. His profit and overhead expenses must come from an additional payment made by the government amounting to 6 per cent. of his expenses as enumerated above in cases where the work costs over $3,500,000 and running up to 10 per cent. if the total is under $100,000. The total amount of this percentage payment will in no case be allowed to run over $250,000, no matter how high the total cost of the work may be.

The value of any construction equipment furnished by the government is not included as a part of the cost of the work when determining the contractor's percentage, nor any uninsured fire or liability losses which the government may pay to him under clause 8, nor any payments by the government for freight, nor any of his overhead expenses. The contract fixes his compensation on the cost of work done by subcontract at 5 per cent. and on the reconstruction of damaged work not over 7 per cent.

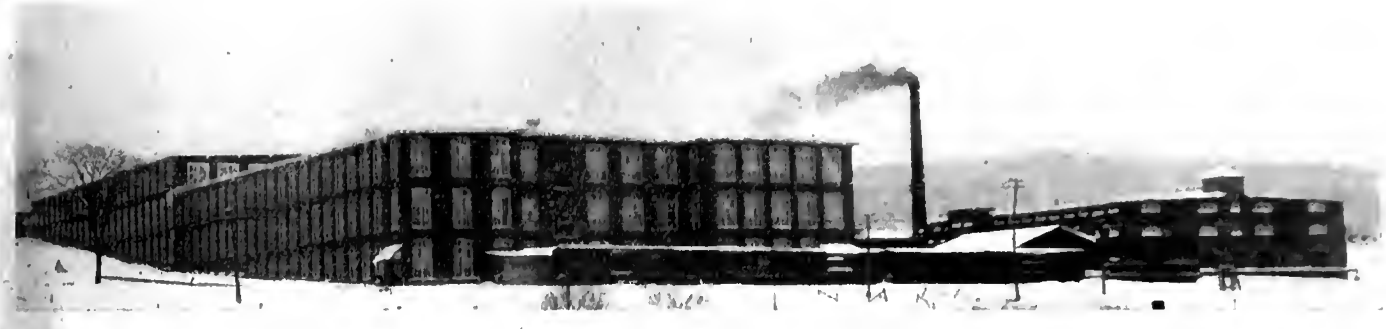


Fig. 1—Plant of the Canadian Connecticut Cotton Mills Company at Sherbrooke, Que. The original mill is in the foreground with the new extension to the rear.

Cotton Mill Extension at Sherbrooke

New Factory of Modern Mill Construction—Provision Against Vibration—Exceptionally Good Lighting Arrangements — Rapid Erection

SINCE the Canadian Connecticut Cotton Mills Company first established in Sherbrooke, Que., in 1912, the policy of this new Canadian industry has been one of co-operation, of efficiency, and of progress. A striking evidence of this last is the splendid new addition which the company has just completed, and in which machinery is now being installed. This concern is the sole manufacturer in Canada of tire duck made from Sea Island and Egyptian cotton. The business has expanded in proportion with the automobile trade of Canada, and the confidence of the management in the future is evidenced in the fact that, besides the land for the extensions which are the object of this article, they have bought an additional ten acres. They have also bought a tract of land adjacent to the mill for the purpose of supplying attractive homes for their employes.

Most Modern Mill Construction

The plant is designed in accordance with the best type of modern mill construction, and is similar to recent constructions in the large mill towns of the New England States. The building is an imposing structure; the spacious lighting provisions and the rounded brick piers which form the walls compel attention and make a most satisfactory impression. The new extension is 200 feet by 115 feet, three storeys high, and there has also been provided a new bonded warehouse 100 feet by 130 feet, also three storeys high.

The construction is somewhat heavier than is usual in factory buildings, it being necessary to provide against vibration from the cotton machinery. The foundation walls are of concrete, mixed one part cement and five parts bank gravel, and waterproofed throughout by the integral method. These walls vary in thickness, the parts which act as retaining walls being heavier than the rest. The main walls consist of brick piers with rounded corners, 24 inches thick on the lower floor, reducing to 16 inches on the third floor. This exceptional wall thickness is necessary owing to the unusually large windows, full-size windows being 8 feet wide by 12 feet high. On account of the great humidity prevailing in the mill, all the windows are double-glazed, to avoid frost in severe weather.

Each storey is 16 feet high, the floors being carried

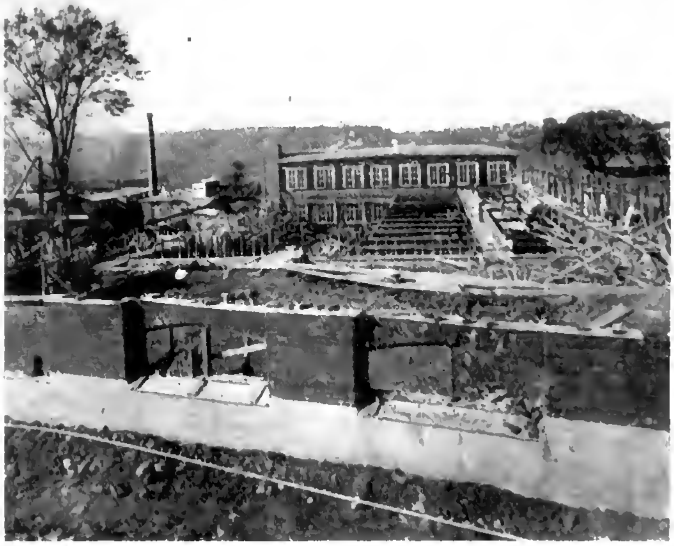


Fig. 2—The new mill in the foreground under construction, the old mill in the background.

Fig. 3—Steel work proceeding for the third floor. Cast iron columns and I-beams are used with timber floors.

on round cast-iron columns 8 inch, 7 inch, and 6 inch in diameter on the respective floors. The floor construction consists of 15 inch Bethlehem beams at 11 foot centres, supporting a 4 inch mill floor, on which is laid one thickness of tongued and grooved boards and clear maple flooring. The building is covered with a tar and gravel roof, sloping to the outside, the water which drains off the roof being carried away by a concrete gutter running around the whole building.

Special Features

Each floor is provided with lavatories for men and women, these, with the elevator, being in an extension on one side of the building. The lavatories have Terrazzo floors and enamel brick walls. The building is painted throughout with white mill paint, this, with the high ceilings and large windows, producing an exceptionally good lighting effect. A vacuum system low-pressure steam heating is used. Compressed air lines for cleaning purposes are provided.

It was hardly three months from the time the excavation work was started till the roof was on the building. The contractors were Messrs. Loomis & Dakin, of Sherbrooke. The accompanying photographs show the progress of the work.

No. 1—Showing the original mill and the new extension in the rear.

No. 2 shows the old mill in the background; on the left-hand side is the bonded warehouse, under construction; the progress made on the basement and the first and second floors is also illustrated.

No. 3—Second floor completed and erection of steel work for third.

No. 4—Roof on building; elevator pent house not being completed.

Fig. 4—New mill with roof completed.

Submarine Coal Mining in Eastern Canada

Large Proportion of Cape Breton's Coal Output Comes From Undersea Workings—Dangers and Difficulties Attend Operations

COAL has been mined under the sea for many years in Cape Breton, N.S., and in future the bulk of the coal output of this land will have to come from submarine territory. In fact, the time is not far distant when the percentage of submarine coal will exceed that of the coal taken from the land areas, taking the province as a whole. Some of the workings extend far from the shore line, one of the most extensive, for example, occupying an area of three square miles under the entrance of Sidney harbor. The face of the deeps, in 1916, was about 1¾ miles distant from the shore line, and the workings are being further extended so as to give access to areas distant 3½ miles from shore. As submarine coal mining involves a number of complex problems, the following notes, taken from a recent report covering the coal fields and coal industry of Eastern Canada, will be of interest:

The most notable submarine area is the seaward extension of the Sydney coal field. So far as can be surmised from the geological indications on land, there is no reason to anticipate any abrupt termination of the coal seams, or any limit to their accessibility, except those imposed by the difficulties attending the extraction of coal at a point remote from the source of ventilation and mechanical power, among which problems not the least will be the expeditious transportation of the workmen to and from their work. The balance of probability is for the uninterrupted continuance of submarine coal seams beyond the physical limits of extraction, but, nevertheless, the exact conditions can only be established by exploration.

Mining Possible Six Miles From Shore

In calculations that have been made as to the available tonnage in these submarine areas it has been usual to assume three miles from shore as the limit of extraction, but it seems reasonable to assume, from experience in other submarine coal fields, notably the Cumberland coal field on the west coast of England, that it will be found possible to mine coal up to a distance of between five and six miles from shore. How much farther seaward mining can be prosecuted only time and actual experiment can demonstrate. An important factor will be the inclination of the coal seams, but so far as the Sydney submarine area is in question, the seams here dip so gently that the actual horizontal distance to be traversed will set limits to extraction before the depth of the cover, or burden of the superincumbent strata, becomes too great. One limitation will be the cost of mining, and it may be the first limiting factor to make itself felt.

Many interesting problems suggest themselves as likely to arise as the extraction of the submarine areas proceeds, but the mining of the more remote areas will scarcely come within the lifetime of the present generation, whose obvious duty it will be to so prosecute the work of extraction as not to imperil the accessibility of the remaining submarine coal.

At Least 180 Feet of Cover

The provisions of the Coal Mines Regulation Act of Nova Scotia, relating to submarine mining, are tentative, and recognize the impossibility of making rigid rules where so much has yet to be learned from actual experience. No submarine coal is allowed to be wrought under a less cover than 180 feet of solid measures, but submarine passageways may be driven to win coal under not less than 100 feet of solid measures. When there is less than 500 feet of solid cover, submarine workings must be laid off in panels of not more than half one square mile in area, surrounded by barriers of coal not less than 90 feet thick, and pierced by not more than four passageways having a sectional area not greater than nine feet in width and six feet in height.

The present law has not attempted to deal with the extraction of pillars in submarine territory or to regulate the method of extraction where the solid cover exceeds 500 feet, except in making this conditional on the approval of the inspector of mines. The size of pillars to be left in submarine workings now proceeding or projected has in all cases been the subject of an agreement between the inspector of mines and the owners of the mines affected. There is reason to believe that future practice in submarine areas may permit the complete extraction of the coal without having any supporting pillars. It may also be found possible to use with advantage the method of "flushing" now largely adopted in European and in some United States collieries, by which the space left by the extraction of the coal is filled by sand or similar material "flushed" into the waste by admixture with water, and led into the workings by a specially-constructed piping system from the surface.

Complete Extraction Preferable

The complete extraction of the coal permits of a more even settling down of the superincumbent measures, and lessens the danger of a break in the measures which might let in the sea-water.

If it is found necessary to leave permanent pillars in submarine workings, this will entail the complete loss of the coal contained in the pillars, and it will also bring into operation the limitation of extraction by the increased cost of mining at an earlier date than if it is found possible to dispense with permanent pillars, as the existence of a large area of permanently abandoned workings supported by pillars increases all mining costs, particularly that of ventilation, and adds an element of danger that is not present where the abandoned waste is completely filled, either by complete subsidence of the roof or by some method of stowing.

If the system of mining in panels, now prescribed by the law, is followed, considerable care will have to be bestowed on the projections of the submarine workings, so as to avoid the exact superimposition or crossing of panel barriers in a higher seam upon the panel bzarriers in a lower seam; for presumably, if a solid block of coal surrounded by an extracted area in a lower seam were exactly superimposed by a similar block also surrounded by an extracted area in a higher seam, or higher seams, the result would be a "hump" or inequality in the sea bottom, with a tendency to break the strata and let in the sea.

Difference of Conditions

There is a marked difference between the conditions attending submarine mining on the western and eastern sides of Cape Breton Island. On the western side, in the Inverness coal field, the strata are much fractured, and the coal seams dip steeply. In the Sydney coal field the seams are but slightly inclined, and the strata overlying and intervening between the coal seams consist of strong sandstones and impermeable marls and shales. Faults are rare, and the sea bottom is usually rock, without great thicknesses of sand or sand pockets. A great part of this submarine coal field is territory that has been gradually encroached upon by the sea, not by subsidence of the measures, but by erosion of modern date, geologically speaking. As the land area of the productive measures is remarkably free from faults or evidences of recent earth movements there seems no reason to anticipate the existence of faults in the area that has been encroached upon by the sea.

Sea Flooded Two Workings

Two mines in Inverness County have been flooded by water from the sea. The Mabou mine was flooded in January, 1909, and the Port Hood mine in June, 1911. At the point in the slope of the Mabou mine where the sea entered there was only 110 feet between the roof of the slope and the sea bottom. In the Port Hood mine the water entered at a point where pillars were being drawn in the lowest level, supposed to be covered by 942 feet of solid measures. The inrush is estimated to have amounted to 3,000 gallons a minute in the initial stages, and the flow of the Mabou mine is thought to have been about 700 gallons per minute.

While the actual physical conditions that led to the inundation at Port Hood are a matter of conjecture, and can probably never be exactly determined, it does not seem reasonable to suppose that the water from the sea entered through a vertical, or approximately vertical, fracture in the roof of the seam communicating directly with the ocean. The connection with the sea is undoubted, because the water is certainly sea-water, and there was noticed a small daily rise and fall of the water corresponding in time to the tides, showing that the point of entrance of the water was near the shore, where the fluctuations of the tide would manifest their influence.

Pumps and Lodgments Needed

The pumping equipment of the mine had a maximum capacity of 110 gallons per minute, and was, of course, entirely inadequate to deal with an inrush of water of any magnitude. There was no reserve lodgment for water, and, under these circumstances, it cannot be said the inundation was an uncontrollable one. Much larger streams of water are being daily controlled in other Cape Breton collieries than seems to have entered at Port Hood. The occurrence has served as a warning, and the necessity for emergency pumps and adequate lodgments in submarine areas was emphasized by this incident.

Difficulties in Gauging Seam Relation

As there are no landmarks at sea, it will be necessary, when two or more seams are being worked in the same submarine area, to superimpose the plan of the workings of one seam upon those of the others, in order to gauge their relationship to each other, for where a number of seams are so shown the result is very confusing. One method that could be used would be to paint a skeleton plan of the workings in each seam on plate glass, each seam being painted in a different color, the plate glass sheets being placed one above another in natural order. This method has been successfully used to show intricate workings in faulted ground in the German coal fields. The German engineers went a little further, however, and made their model to exact scale, both horizontally and vertically, showing the dip of the seams and the fault lines, so that the completed model represented in miniature a transparent cube of the earth's crust containing the mine workings.

The surveying and plotting in the submarine areas will have to be very accurately done, and subjected to most rigid checking, as there will be no opportunity for such useful checks as are made possible in land areas by shafts and boreholes.

Road Work in the War Zone

Assistant Director of Roads With the British Army Describes Methods of Maintaining Roads—Guns and Men Must Be Kept Moving

ROAD-BUILDING in the war zone of France and Belgium is by no means an easy task. The following extracts from a letter recently received from Lieut.-Col. W. G. Mackendrick, president of the Warren Bituminous Paving Company, Ltd., of Ontario, explains some of the difficulties that are met with in providing transportation facilities behind the lines. As recently mentioned in the Contract Record, Mr. Mackendrick, who is a Toronto, Ont., man, was recently promoted to assistant director of roads, with the rank of lieutenant-colonel, in charge of the road work of the Fifth British Army in France. Portions of his letter, which describe his particular work, are reprinted herewith:

"All the roads in France and Belgium are macadam or macadam with stone setts on sand in the centre of roads, except in the towns and villages, where the main streets are mostly stone setts or pavic, as they call them here. Nearly all French roads are of very light construction—from four to six inches of gravel or stone and a few inches of chalk or sand. They do not stand up under the intensive traffic in the army areas of the three and five-ton lorries, guns, etc., and in the spring, fall, and winter it is a case of strengthening them with macadam, slag, mine refuse, chalk, old soft bricks from the destroyed villages, or anything that can be had. For bad places, wet and swampy, we use sleeper roadways—i.e., railway ties on three bearers, spiked down, or three-inch plank roads on three bearers, or corduroy roads similarly built.

Soling Laid Flat

"When building roads in France or Belgium we used to adopt Macadam's methods of standing large stones on end, hand-placed, and then breaking off the tops and placing macadam on top and rolling. I found, however, that for this climate on wet soil this method was very expensive, as the huge lorries drove the stones down into the mud, and they kept on sinking. Accordingly, I adopted the method of laying the large stones, or soling as they call it here, on the flatest side, to give good bearing, so it would carry the lorries better, and then filling macadam on top of this in dry weather, rolling and consolidating as usual and binding with mud off the side of the road. In wet weather we first place the soling with more on top, and let the traffic wiggle it into shape. No rollers are used in winter, as they block traffic too much, and are unnecessary.

"The road from Albert to Bapaume was rebuilt and recoated in this way, and we carried all the army on it without a roller on the road until the dry weather of May, when we started to put a regular coating of macadam on it, and had eight rollers, working two shifts per day, licking it into shape.

"Time is the factor in all advance road work such as is only possible in these armies, as, from the minute an advance is made by the infantry, the guns must go up in support, and the munitions must go up constantly thereafter, and whatever can be got to make the roads usable is the thing for the army. We carried all the roads in the recent advance for many weeks, with repairs made to all the shelled sections—which in the worst spots comprised from 80 to 90 per cent. of the road near and in villages—with the bricks and building chalk from the destroyed buildings in the nearest village. The traffic grinds this material into powder, and in wet weather into mud, and it had to be renewed every day or two; but, with stone costing 30 shillings a ton and at any price not available, we had to use what we could get. We have built many miles of railway sleeper roads for temporary use.

Cost No Consideration

"Cost never enters into the question here when we are moving. Whatever we can get that will hold up the guns and traffic is used. Trees, old sleepers, rafters, and so forth, from houses in the demolished villages are laid down to enable the guns and regiments to get along and keep moving. In many cases we could only make roads good enough for the horses to pull in the ambulance carts, and limbers could not be taken in over the only available roads until many days' or weeks' work had been put on them. I have had 10,000 to 12,000 men working for many months, and have used up to 2,000 tons of metal a day, not counting corduroy, sleepers, pit-props, or brick. When possible we fill all holes with broken bricks and fill four to six inches macadam on top for a wearing surface, and all the while we must keep the traffic moving, usually two ways, on roads 16 to 18 feet wide."

Montreal Contractors to Employ Percentage Method to Offset Increased Costs

ALTHOUGH the Montreal building permits show a decrease during the last two months, making the total for the first half of the year slightly less than in the corresponding period in 1916, building supply houses report a fairly good volume of business. This is due to the improved demand from points in the province where construction is satisfactory. It is, of course, still below normal, but, in view of high prices, the situation may be regarded as encouraging. As in 1916, the larger new buildings are mainly for church and educational purposes. Some Montreal contractors state that they do not intend to tender for new work unless on a percentage basis. They take the view that, provided conscription passes, there will be a further depletion of the labor market, and that bricklayers and other classes of help are likely to take advantage of the situation to insist on still higher wages. The bricklayers recently put forward a demand of this nature. The larger wages bill would affect any contractors who obtained jobs based on the present schedule, and, in order to guard against such contingencies, some firms are not willing to tender for buildings on the basis of a stated sum. A percentage allowance would provide for increased costs.

Experiments on Cement Constituents

"Properties of the Calcium Silicates and Calcium Aluminate Occurring in Normal Portland Cement" is the title of the technological paper, No. 78, just issued by the United States Bureau of Standards. It is by P. H. Bates and A. A. Klein.

Scheduling Progress on Construction

Specially Arranged Chart Provides Graphic Record of Progress on Big Job—Required Time for Each Step Determined in Advance

A PLAN has long been sought whereby the number of men needed at each step in the construction work and the time of delivery of each item of material for the job can be definitely known before the job is started. We reproduce below the progress chart used recently by the Aberthaw Construction Company, of Boston, to show what can be done along this line. The building to which this chart refers was a five-storey structure, 490 feet long by 60 feet wide, with two wings approximately 60 feet square.

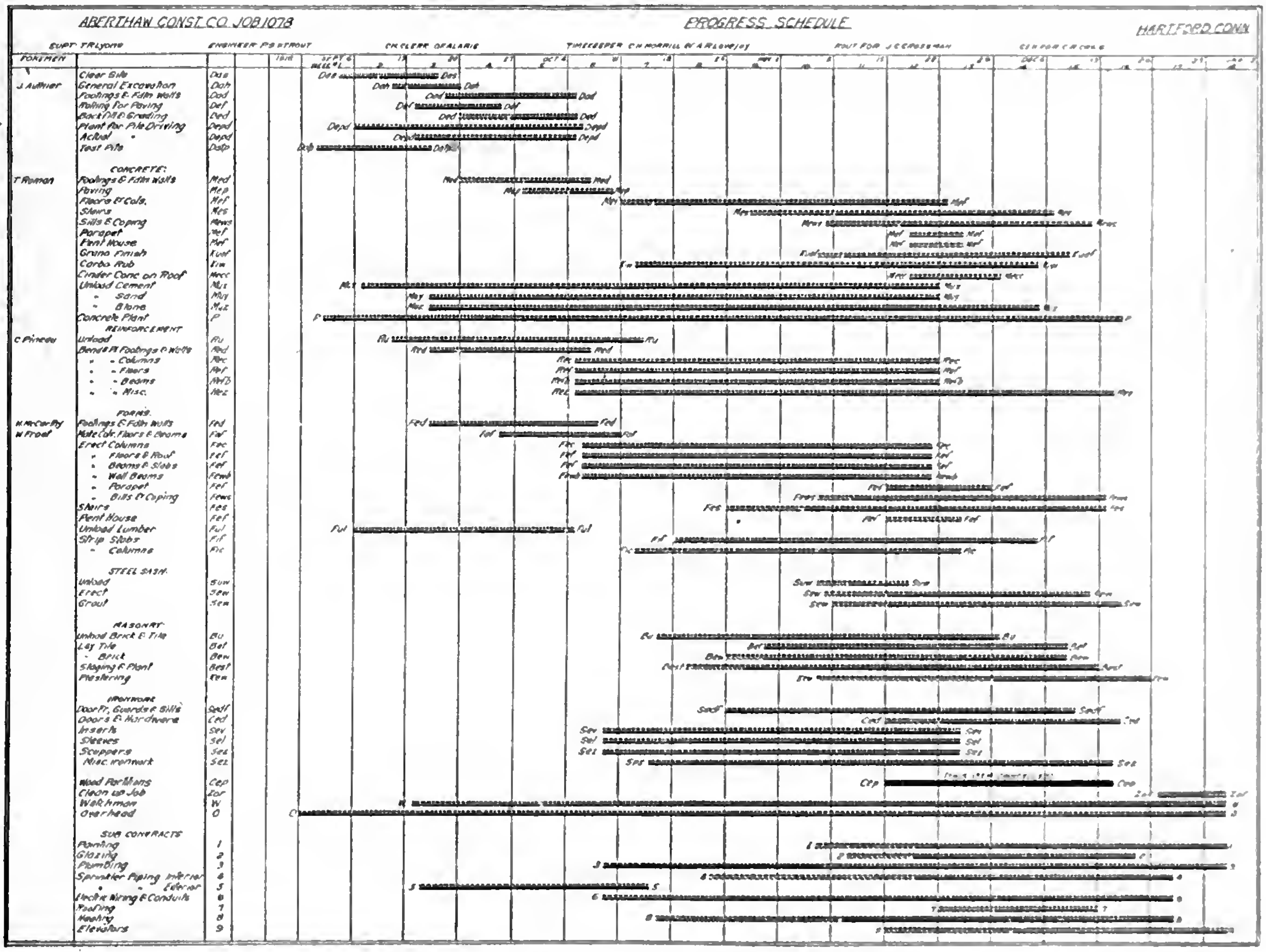


Chart which records progress on construction work and indicates whether predetermined schedule is being followed. Key:—Solid line is drawn in white, horizontal dotted line in yellow, and diagonally dotted line in red.

As soon as the job was awarded this company made a probable square foot of floor cost and began clearing the site. Meanwhile bids were secured on footings and pile foundations.

Plant Located After Quick Survey

Coincidently, after a quick and thorough survey of local conditions, such as the available vacant land, the railroad siding, and the probable streets along which materials could be delivered, and nearby sources of material that would be required, the engineering department made its first plant layout. Bins, sheds, and office buildings were located and the place allotted for every class of material arriving on the job. This layout was subsequently perfected.

At the next weekly conference of the contractor's staff the entire job was taken up for discussion and definitely organized. At this conference were present the men who secured the contract, the general superintendent, the chief engineer, the purchasing agent, and the schedule engineer. A building superintendent was selected, together with his principal assistants, the carpenter, labor and planning foreman, engineer, and the master mechanic.

The discusion covered plant layout, including number and location of mixers, method of distributing the concrete, purchase and handling of lumber for forms, requirements in the way of steel and cement, prices and deliveries of these materials, architect's drawings, tentative progress schedule, and many minor questions. When each man left the conference he had a definite idea of the part he was to play in the new work.

As a basis for all operations the schedule engineer immediately perfected his progress schedule. Between the reports of the schedule engineer and the chief engineer the architects were constantly kept informed as to the dates upon which drawings must be in hand, while the requirements in the way of form lumber, steel, cement, etc., were furnished to the purchasing agent. The latter's responsibility ended when he had placed an order subject to specific deliveries. The job superintendent, being informed of the conditions of these orders, thereafter assumed responsibility for the direct following up of the required materials. All cases that he could not handle were referred back to the traffic department of the main office. In the case of sub-contractors who were manufacturers, schedules were furnished and close touch was kept with the dates of beginning work and shipping finished products ordered.

Supplies Kept in Reserve

On this particular job the situation was complicated by the New England freight embargo, but by having some source of supply always held in reserve serious delays were avoided. Plant equipment, small tools, and stationery were requisitioned by the building superintendent upon a very complete blank furnished for that purpose. This blank covers everything required in the way of "plant," from band-saws to vertical engines, of small tools from anvils to wrenches, and of stationery from pay envelopes to rubber stamps. It is the business of the "yard" to keep its stock complete in each of the items so that shipment may be made without delay.

Following the requirements of the plant layout, offices and storehouses were shipped from the contractor's yard, each building being made of standard sections 15 ft. wide in 10 ft. lengths. As soon as the cement schedule was made out the order was placed, the storehouse was filled in advance of requirements, continuous shipments from the cement mill were maintained, and arrangements made with a local dealer so that his supply could be drawn upon in case of emergency. All scheduled form lumber cut to dimensions was turned out by a local mill, delivered by truck to the job, and piled separately, according to size, and ready to use.

Chart Records Progress

The progress chart, which graphically represents the dates and limits and serves as a basis for recording progress, is reproduced herewith. Three blueprints of it are sent to the job—one for the superintendent, one for the routing clerk, and a third to be brought up to date weekly and sent to the Boston office. Another copy is kept on the board in the Boston office, and is brought up to date weekly from the copy sent in by the job.

On the blank blueprint each item of work is represented by a wide white line. When the work is started it is recorded on the sheet by drawing a yellow line over the upper part of the heavy horizontal line. The length of the yellow line is made proportional to the amount of work done on that item, the entire heavy line representing volume rather than time, although it spans the period between the scheduled beginning and ending. It is, therefore, evident that the ratio of the length of yellow line to the total length of the heavy line represents the proportion of that particular item of work which has been completed.

Progress Seen at a Glance

When the work does not start on time a red line is drawn over the lower half of the wide line and is continued to the date when the work stops. Then the yellow line is begun in its proper place. The red line, therefore, shows at a glance just how far behind the work is upon a given item.

Each week a piece of string is stretched vertically across the chart from the current date shown at the top of the sheet. If at any time the yellow lines extend beyond the string it indicates that the job is ahead of schedule on that particular item.

Thus the progress of the entire job is visually shown from day to day on the bulletin board in the home office.

Outremont Has Called Tenders for Incinerator

THE incinerator for which the city of Outremont, P.Q., have called for tenders is to be built on Wiseman Avenue, near the C. P. R. tracks. The structure will consist of a stoking floor, and above that a receiving floor reached by a driveway. The feed holes for charging the furnace are to be situated on this floor. The ashes will be removed by a truck running on rails and placed under the incinerator or the cells. The plans provide for a bin to store 15 tons of garbage. The foundations for the building and chimney will be constructed of concrete and the superstructure above the receiving floor of brick or stone, with steel roof truss, slate or tile roof, wire glass windows and fireproof doors. A small office room will be built on the charging floor, where the recording instruments will be located. The chimney is to be of reinforced concrete or of radial brick. It is specified that the building is to be designed large enough to permit of additional cells in case it should be desired to double the capacity of the incinerator, and also to install in the future a 100 h.p. boiler.

The incinerator is to be capable of burning fifteen tons of garbage or refuse, or of garbage and refuse mixed, in a continuous run of ten hours. The specifications provide that the burning must be conducted so as not to produce offensive odors either at the incinerator or from the chimney. The residue from the furnace is to be thoroughly burned and must not contain more than one per cent. of organic matter, exclusive of carbon. The efficiency clause is to the effect that when burning kitchen garbage only at full capacity on a continuous run of 16 hours, the incinerator must not require more than 200 pounds of coal or equivalent per ton of garbage consumed.

Vancouver's Sewer Pipes

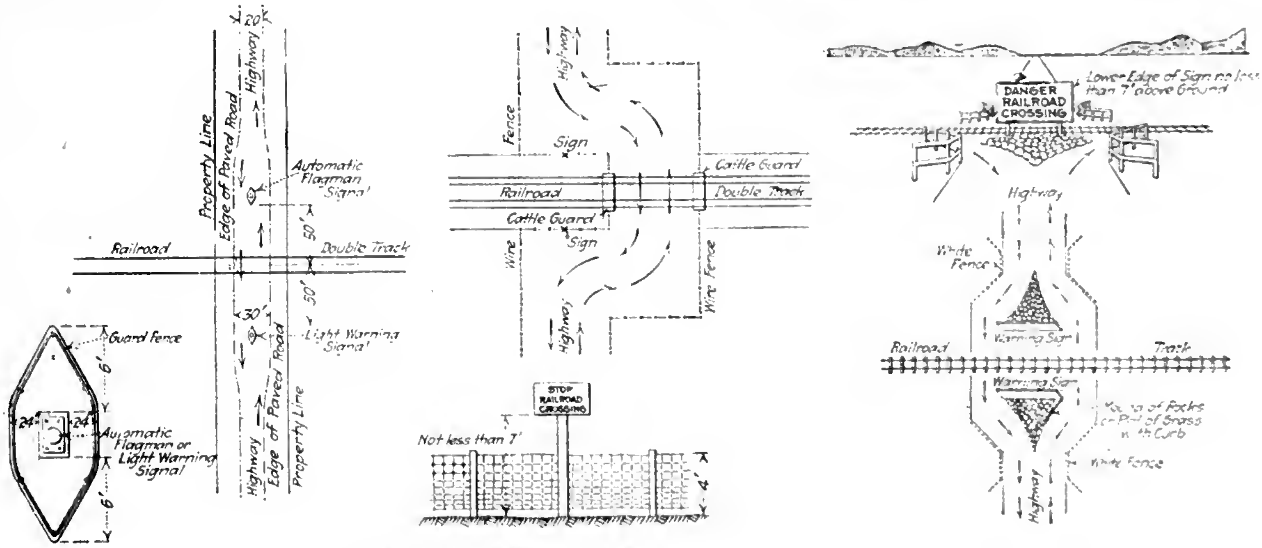
The city of Vancouver, B.C., in the course of the last five or six years, has laid a considerable mileage of cement sewer pipe, manufactured by a local company, and the example thus given was followed by the city of New Westminster and a number of smaller municipalities. It is said that recent discoveries made by officials of the Vancouver sewerage department seem to have led to the belief that the cement pipe is not standing up well in its work, and that a serious mistake was made in the selection of that type instead of the vitrified article. The matter is now being investigated by the Board of Works Department of the City Council.

The Canadian Society of Civil Engineers has received an invitation to send representatives to the 11th annual convention of the Western Canada Irrigation Association to be held at Maple Creek, Sask., on August 1-3.

Safety at Grade Crossings

Layouts Aiming to Prevent Mishaps by Warning Traffic and Causing it to Reduce Speed

THE grade crossing is the most dangerous hazard on the public highway. Statistics show that by far the majority of accidents to road traffic occurs at the location of grade railway crossings, and, further, that a very large proportion of the mishaps at these points are due to carelessness on the part of drivers of vehicles, who cross the tracks without regard to the dangers that are possible. Various devices have been employed to make grade crossings immune from danger. The simplest and by far the most widely used schemes are the simple signs and automatic bells. The sign, however, does not exert any deterring effect, but simply gives warning of the proximity of a grade crossing. A serious objection to the sign as used by the railways at the present time is that its location is not sufficiently in advance of the crossing to give adequate warning to traffic. Unless the road is straight and free from sight hindrances the sign is practically of little use. It has been found also that familiarity breeds contempt, and that the sign does not produce the results intended.



Three arrangements of grade crossings designed to reduce accident hazard.

Bells and Gates

The automatic bell represents a further step toward safety at grade crossings. The bells, however, are very rarely audible for more than very short distances, and, for this reason, are often ineffective. In very many cases the mechanism does not operate properly, allowing the bell either to ring continuously or not to ring at all. In such a case the installation is perhaps worse than useless.

The manually-operated gates, so common to urban crossings, find little application on rural highways owing to their high maintenance and operating cost, which makes them usable only under heavy traffic conditions.

Bumps to Check Speed

More intricate schemes have at various times been proposed to avert danger, these aiming to obstruct traffic sufficiently in advance of the crossing to cause it to slow down to a speed which will not be risky. A very common method frequently employed on rural highways is to provide a series of bumps for a distance of a hundred yards or so approaching the crossing. These bumps are of such dimensions and spacing as to cause motor traffic to slacken speed and warn it of impending danger. More elaborate schemes are illustrated in the sketches herewith. The first, which is the simplest, involves automatic flagmen or light warning signals in the centre of the highway, 50 feet or so on either side of the crossing. These are surrounded by guard fences and the road is deflected to the sides. In this case not only does the automatic signal give warning of approaching trains, but the slight deflection in the road alignment affords additional protection, and helps to reduce the danger if the signal is not in working order.

In the second scheme illustrated the road is carried to the side some 20 or 30 feet, and signs with suitable fencing are provided to warn drivers of the sharp turn at the crossing. All obstructions in the line of vision are removed for some distance, so as to give a clear view of the track. On approaching the crossing the apparent ending of the road will produce a slackening of speed and enable the driver to cross in comparative safety.

Road Forked at Crossing

Another layout is shown in the third sketch. In this case the road is forked at the track, each arm taking only one-way traffic. A sign placed in the centre of the highway gives warning of the crossing. This sign is protected by a mound of rock or plot of grass with a curb, which also serves to deflect the traffic along the fork. Fences, preferably painted white, form additional precautions.

These schemes, with others of a similar character, are being widely adopted in localities where grade crossings present dangers. The ones shown have been compiled by the California Railway Commission, and are considered by them as extremely admirable as preventives of serious accidents.

The Coal Industry in Eastern Canada

The Mines Branch of the Dominion Department of Mines has just issued an extensive and well illustrated bulletin, entitled "The Coal Fields and Coal Industry of Eastern Canada." The report is a general survey and description covering the geological, historical, and economic aspects of coal mining in the Maritime Provinces.

Heap Test Forms Easy Field Method of Measuring Concrete Consistency

IT has been frequently pointed out that concrete mixed to an improper consistency is apt to be lacking in strength and uniformity, but that the correct proportion of water to use varies greatly with the fineness, porosity and wetness of the aggregates and the amount and kind of cement. A need has been felt for a quantitative method for measuring the consistency of concrete, so that this quantity might be specified more accurately than by the usual descriptive terms such as "sloppy" or "mushy." Prof. H. A. Thomas, writing in Engineering News-Record, describes such a quantitative measure which depends on the "angle of repose," or steepest surface slope that can exist on an unconfined mass of freshly mixed concrete. It is evident that in general this slope becomes flatter as the consistency becomes wetter. A number of experiments were made at Rose Polytechnic Institute to see if a simple, certain and practical method could be found for measuring the angle of repose of a sample of freshly mixed concrete. The "heap test" specification described in the following paragraphs is the result of these experiments.

Preliminary Experimentation

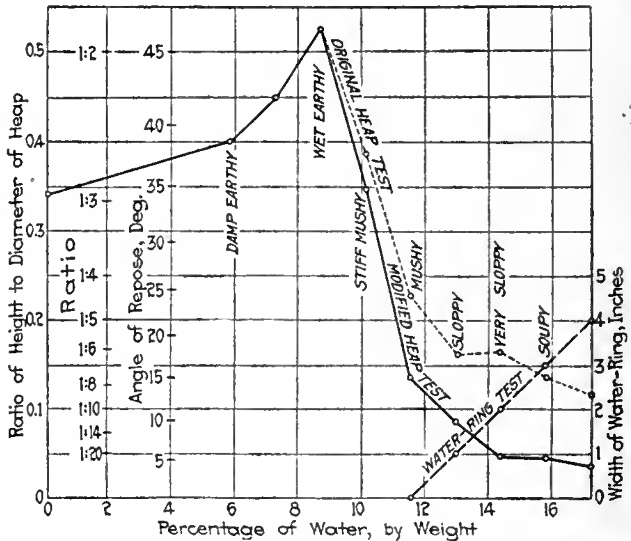
The method first tested was to fill with concrete a vessel, such as a bucket or wheelbarrow, and tip it until the concrete assumed its maximum surface slope, measuring the inclination with a carpenter's level and rule. It was found that, while this method gave slopes varying with the consistency, the surface of the concrete was in many cases so far from being plane as to make the method unreliable for practical use.

The next test devised gave more satisfactory results. In making this test, a sample of the concrete to be tested was placed in a pail and poured out in a heap on a level impervious surface, the height and diameter of the heap giving the data for determining the angle of repose. The pouring was done slowly and with as little free fall as possible. The results obtained by this test on concretes of different consistencies are shown by the dotted line in the accompanying diagram. As may be seen from this curve, the test gives a sensitive measure of the consistency of medium and mushy concretes. It is, however, not so well adapted to distinguishing between sloppy concretes, the reason being that in wet concretes the fine materials separate from the coarse aggregate and spread out, leaving the coarse aggregate in the centre in a clean pile with steep slopes. The ratio of the height to the diameter of the entire heap, which measures half the tangent of the angle of repose, therefore changes but slowly after the concrete becomes so wet that there is considerable separation of the aggregates.

After some experimenting it was found that the heap test would give more sensitive results in the case of sloppy concrete, when modified as follows: A pailful of the freshly mixed concrete was slowly poured out in a heap on a level impervious surface as before, but instead of emptying the pail, the pouring was stopped as soon as the concrete began to pile up so that the slope near the centre of the heap was steeper than near the edge. In the case of mushy concrete this occurred when the pail was about three-fourths empty, and in the case of very sloppy concrete when the pail was about one-fourth empty. The solid line in the diagram shows results obtained by this test. It is seen to be more accurate than the preceding test in differentiating between sloppy consistencies, there being 300 per cent. variation in the ratio of the height to the diameter of the heap, between the mushy and very sloppy concretes experimented upon. It was found that the results of the test were not affected by considerable variations in the speed of pouring or quantity of concrete used.

Soupy Concrete Gave Trouble

In the cases of concrete of "soupy" consistency, even the method just described failed to give a good quantitative distinction between different degrees of wetness, as may be noted from the diagram. In working with samples of concrete of this kind an additional peculiarity of the heap test was observed, which not



Results Obtained By the "Heap Test" for the Consistency of Concrete

Description of Consistencies:

"Damp earthy"—Water will not flush to the surface after prolonged tamping.
"Wet earthy"—Ordinary dry concrete. Water flushes to surface with moderate tamping. Quakes slightly.
"Stiff mushy"—Water flushes freely to surface with slight tamping. Mixture quakes considerably.
"Mushy"—Medium consistency, wet, muddy appearance. Quakes freely. Flows easily down chute at 34 degrees. Tamping not required.
"Sloppy"—Excess water separates easily. Hard to keep aggregates together. Flows readily down chute at 17 degrees.
"Very sloppy"—Impossible to keep water and aggregates together when not in motion. Flows down chute at 13 degrees.
"Soupy"—Large excess of cement-laden water will not combine with aggregates.

only affords this distinction, but appears to give a practical measure for a property of considerable importance in wet concretes—the segregation of the cement and aggregates. The very wet concretes experimented upon showed so strong a tendency toward segregation that the heaps consisted of three distinct zones: An inner pile of clean, coarse aggregate with steep slopes, an intermediate zone of fine aggregate with moderate slopes, and an outer ring or pool of cement-laden water. When this separation occurred to a considerable extent, the ratio of the height to the diameter of the heap changed but little with increasing wetness. The width of the ring of separated water was found to increase rapidly with the general wetness of the concrete, as is indicated by the dash line in the diagram. It was quite constant for samples of a given consistency, but increased slightly with time, one minute after pouring being taken as standard. The measurement of the average width of the ring of cement-laden water surrounding the aggregates in the heap test may therefore be used as an additional quantitative criterion for the consistency of wet concrete. It also gives a numerical indication of the tendency toward separation of the ingredients.

To see if a more precise method could be obtained for measuring the tendency toward segregation, a number of tests were made by placing the wet concrete samples in various kinds of screens and strainers and measuring the percentage of water and fine material separating. These methods were found to give less uniform results than those obtained by measurement of the width of the ring of separated water in the heap test.

Somewhat Similar to an Earlier Test

The heap test is not well adapted to specifying the consistencies of very dry concrete. As shown by the diagram, in the case of dry concrete the height of the heap increases instead of decreasing with wetness, until a value is reached corresponding with the maximum internal cohesion of the damp materials. A test suitable for measuring the consistency of stiff plastic mortar or concrete is described by Cloyd M. Chapman in the Proceedings of the American Society for Testing Materials for 1913. This test "consists in depositing the mortar or concrete in a form of suitable size and shape resting on a non-absorbent surface, such as glass or metal, and then removing the form and noting the settling or sloughing down, either with or without the assistance of a jar or shock, of the upsupported mass of paste, mortar or concrete left standing." The test is stated by Mr. Chapman to be useful only for material that is "not too fluid to have a tendency to retain its form when at rest." It is thus applicable to concrete stiff enough to require tamping for consolidation in practice.

In experimenting upon the heap test a number of trials were made, forming the heap of concrete by placing the material in a form, such as a bottomless inverted pail, and removing the latter as in the test above described by Mr. Chapman. The heaps obtained in this way with mushy and wet mixtures gave less uniform and satisfactory results than were obtained by pouring the concrete out of a pail.

The Heap Test Defined

The results of the preceding observations may be summarized in a specification for the consistency of concrete. The amounts in parentheses are given as illustrative for mushy concrete, and not as absolute values applicable to all materials and conditions. "The concrete shall be mixed to such a consistency as to form a heap whose height is not less than (one-tenth) nor more than (one-fifth) of the average diameter of its base, when poured as follows: A sample of the concrete of volume not less than 2/3 cu. ft. is placed in a pail or tub and poured from the same slowly, in one place, on a level impervious surface, and with as little free fall as possible, stopping as soon as the concrete begins to pile up so that the slope near the centre is steeper than near the edge. If in this test water separates from the concrete so as to surround the heap in a ring more than one-quarter inch in average width at one minute after pouring, the consistency will not be considered satisfactory." A more complete specification covering this test should mention the method and place of taking an average sample, the number of occasions on which the test is to be made and the responsibility for the labor involved.

The 2/3 cu. ft. specified to be used in making the heap test is intended to apply to mixtures with aggregate up to about 1½ inch in diameter. For coarser aggregates this quantity should be increased. In making the test the height of the heap is most readily found by thrusting a wire or small stick down through the concrete. The point at which the concrete begins to pile up at the centre of the heap was well marked in the concretes on which experiments were made. If this point is slightly overrun in pouring out the concrete, the projecting fragments of coarse aggregate should not be included in measuring the height of the heap.

Concretes Used in Tests

The concretes used in making the tests described were 1:2:4 mixtures using local sand and screened gravel. How the numerical results would vary with other materials would have to be determined by trial. While a series of experiments applying the heap test to a large variety of materials would be interesting and valuable, those already made show the correctness of its two essential features: That for the consistencies ordinarily used in practice there is a close measurable relation between the wetness of the concrete and the height-to-diameter ratio of the heap and the width of the separated watering. The inference that the latter indicates the tendency toward segregation, while not proved, seems reasonable.

The consistency of concrete which it is best to use on any given work is a matter of judgment, depending on many variables. For this reason caution should be used in writing numerical values in the heap-test specification without knowledge of local materials or conditions. What is usually needed is something to make the results of judgment permanent and uniform, so that when a desired consistency of concrete is once secured with given local materials, it may be exactly duplicated at any time. The heap test is well adapted to this purpose.

What the United States Thinks of the Canadian Railway Problem

THE railway reports recently submitted by the Drayton-Acworth-Smith commission which was appointed to consider Canada's railway problem, have elicited a great deal of comment from all parts of the continent. The United States is very directly interested in the situation and the opinions of those on the other side of the line are therefore noteworthy. Just what a large section of the United States public believes is expressed in an article entitled, "What Shall Canada Do with Her Bankrupt Railways?" in our contemporary, Engineering News-Record. This journal states:—

"Will Canada be able to put her railways on a self-supporting basis, and if so, how? This question is an urgent one indeed. A large part of the Dominion's railway network is a bankrupt wreck, bankrupt many times over. Quick answer is needed.

"As early as half a dozen years ago the question existed, though the people of Canada declined to recognize it. Yet no great prophetic vision was required to foresee that an answer must be given soon. Canada had been frenziedly building railroads for a non-existent population and traffic—railroads carried on a shadowy financial structure propped up by government guarantees, loans and gifts. It was hardly conceivable that the structure would endure.

"Finally the National Transcontinental fiasco opened the eyes of even the optimistic, politician-ridden Canadian public to the dangerous situation. But the problem has now grown beyond the power of any simple curative formula. Brutally radical measures seem to be needed, in which confiscation and repudiation are among the simpler elements.

"Sympathy is due Canada for her plight, but hardly the unqualified sympathy that innocence merits. The financial madness of the past was in part the outgrowth of an honest but unreasoning optimism which could not refrain from using superlatives in estimating the country's growth. But in larger measure it is chargeable to a deadly combination of private exploitation and governmental connivance. It matters little whether this connivance was due to incompetence or to sheer dishonesty of the government officials—Canada as a whole will have to pay the penalty. None of the suggested remedies is claimed to be capable of more than a gradual restoration of solvency for the railroads; the public must continue to make up the deficits for a long time to come.

"Of the three plans (Drayton-Acworth, Smith and Tye) we find it hardest to accept the majority plan of the commission. Mr. Smith's criticisms of it seem conclusive. The Drayton-Acworth scheme is nothing less than government ownership and operation, not very skilfully masked, and some of the commission's own arguments against government ownership, as Mr. Smith point out, condemn the scheme. In saying this we are well aware that a strong tendency exists in Canada toward approval of the majority plan and a virtual ignoring of the minority plan. But it appears that they whose minds run in this direction do not share the commission's own distrust of government operation, nor do they seem to see fault anywhere but in the misdeeds of private capital for the country's present predicament. This is a partial view of the case at best. Aside from the government's part in the troubles of the Grand Trunk and the Canadian Northern, government operation of the Intercolonial has been a dismal failure, and government operation of the National Transcontinental offers no greater promise.

"Hence we hold that the case lies clearly in favor of Mr. Smith's minority plan as compared with the Drayton-Acworth scheme. Between the Smith plan and the Tye plan it is not so easy to choose. Both have good points. The Tye plan is perhaps the more idealistic. Under it three large railroad systems under private ownership—nominally, at least, though only one of them is now solvent—would lose their identity, and it would scarcely be possible to satisfy the conflicting claims and avoid long litigation. If the plan could be consummated it would give the country a unified transcontinental system that would to all appearances have the making of a worthy competitor of the Canadian Pacific. And it would take the National Transcontinental off the hands of the government."

Electric Steel Industry in Canada

Rapid Development in the Reduction and Refining of Ores by Electric Processes — Superiorities of Steel Produced by this Method

THE reduction and refining of iron and other ores by electric heat is one of the promising developments of the near future in Canada, where supplies of both the ore and the power are found in close proximity and in almost unlimited quantities. The steel industry, which has already become a considerable factor in Canadian industry, is bound to be accentuated by the remarkable advances that have taken place within the last five years in the process of electrically reducing and refining ore. As an indication of the extreme importance of the electric steel industry and the advantages accruing from this process, the following notes taken from a paper read before the Manitoba branch of the Canadian Society of Civil Engineers, by A. M. Tirbutt, of Selkirk, Man., will be of value:—

The wonderful growth of the electric steel industry in Canada and the United States during the last few years is best shown, I think, in terms of output. From 18,309 tons made in 1912 it jumped to a total of over 225,000 tons in 1916; and, taking the units installed during the latter part of that year and those at present under construction, the total output for this year, taking the units installed during the latter part of that year and those at present under construction, the total output for this year, taking a conservative estimate, should easily reach the 500,000-ton mark.

To what is this growth due? The war, and this is so, but indirectly, for the war has created an unprecedented demand for all kinds of steel; but why should not this demand have been met with steel made by other processes? The war gave the opportunity, but qualities inherent in the electric process have enabled the electric furance builders and users to realize on the opportunity.

Characteristics of Commercial Steel

After saying this I had better briefly touch on the characteristics of the commercial steel of the present day. Besides the electric there are three other processes of making steel—converter, open hearth, and crucible—and, as it is generally recognized that the last process is best adapted to the production of the highest quality steel, I intend to prove that the electric process is adapted to the production of steels as high in quality as crucible steels.

Mr. David Carnegie, in his book, "Liquid Steel: Its Manufacture and Cost," says: "The advent of electric furnaces has arrested, in some degree, the development of the crucible steel process, but not, it would appear, to the extent looked for by the advocates of the electric furnace. One of the chief hindrances in the progress of the electric furnace is the cost of the electric power required in the process, and it is, therefore, in the manufacture of the higher grades of steel, such as are made by the crucible process, that most is expected from the electric furnace. There is no question about the quality of steel that can be produced in this latest type of furnace."

This book was written in 1913, when the electric furnace was looked upon as an expensive equipment to operate. Since then great strides have been made in furnace efficiency, which, were I dealing with costs, I could very easily show you.

Dr. John A. Mathews, president of the Halcomb Steel Company, of Syracuse, N.Y., a company which operates a large number of crucible furnaces, as well as three large electric furnaces, said in a paper read before the American Iron and Steel Institute in May, 1916:

"With the advent of electric furnaces we have a rival which claims to make steel equal to the best crucible steel. It is interesting to note that the inventors recognize the superior qualities of the crucible products so frankly. Equally frankly I can say, after ten years' experience, that I think they are right."

The reason for the superiority of crucible steel over open hearth and converter, according to experts such as Mr. Bradley Stoughton, is because it is manufactured in a vessel which excludes the air and furnace gases, and is, therefore, free from oxygen, hydrogen, and nitrogen, whilst the process is also under a little better control and receives more care than the other two.

Better Control with the Electric

The control possible with the electric furnace is greater than with the crucible process. For instance, there is always a certain amount of uncertainty as to the amount of carbon content of crucible steel when using plumbago crucibles and to the silicon content when using fire-clay crucibles, whilst the silicon and carbon, as well as other elements, can be controlled perfectly in the electric furnace. Heats can be held in the furnace until accurate analyses are received from the laboratory, after which you can proceed to eliminate anything unnecessary or by adding the necessary materials get the desired chemical analysis in the finished product. In fact, of all the metallurgical steel furnaces the electric furnace is the most susceptible of accurate control with the heat applied directly to the metal in the cleanest way possible—i.e., without the admission of coal, ash, or gas, or air of the blast. The atmosphere in the tightly-closed electric furnace can be made oxidizing, neutral, or reducing at will, according to the slag. In fact, a heat can be held for hours under a neutral slag without changing its quality, or a part of the heat may be cast and the balance worked over to another grade, a convenience which is of great importance to steel founders, especially when big furnaces are used.

The elimination of sulphur is easy, in an electric furnace, as, owing to the high temperature available, a much more basic slag can be used.

Dense Structure and Higher Tensile Strength

A characteristic peculiar in electric steel is its dense structure and high tensile strength. For the same chemical analysis electric steel has a denser structure and higher tensile strength than steel made by any other process. What causes this density of structure has never been discovered, though it may be due to some magnetic influence on the molecules. If a converter, open hearth, or crucible man be shown a fractured test bar of electric steel and asked to judge the carbon content he will invariably estimate five to fifteen points too high.

The average ultimate strength of electric and open hearth steels for the following range of carbon contents per cent., is interesting:

Carbon content	0.08	.12	.20	.24
Open hearth (lbs. per sq. in.)	51.690	56.510	58.294	63.560
Electric (lbs. per sq. in.) ..	59.194	64.080	72.853	69.540

The Thomas Davidson Manufacturing Company, of Montreal, have been melting steel scrap in an acid electric furnace and casting billets for 4.5 h.e. shells for nearly a year, and their record is remarkable, over 90 per cent. of the billets having passed the rigid inspection of the Munitions Board. An average analysis of twelve successive heats poured by this company is as follows:

Carbon, 0.447; silicon, 0.19; manganese, 0.80; sulphur, 0.044; phosphorous, 0.04; yield per gross ton, 21.8; tensile strength gross ton, 44.6; elongation, percentage, 23.4.

Three Reasons for Superiority

Summarizing the characteristics of electric steel, it is my opinion that it can be produced superior to steel made by any other process now in use, because:

1. The steel can be made more uniform in chemical content, and specifications can be more closely met; due to the conditions in the electric furnace and to the process, which is ideal for the controlling of the carbon, silicon, manganese, phosphorous, and sulphur.

2. The steel can be made more solid and free from blow-holes owing to the exclusion of oxygen and the ability to kill your melt by the judicious use of alloys at the right moment.

3. The steel has a denser structure and a higher tensile strength, due both to the exclusion of oxygen and nitrogen and to the peculiar reaction which occurs in the electric process. This, of course, is true in the case of any of the electric furnaces in use today if they are properly handled.

Furnaces Classified

Now, with regard to the classes of electric furnaces used in iron and stel production, there are three, namely, arc furnaces, resistance furnaces, and indirect furnaces, so called according to their methods of applying electric heating.

In the first the heat effect is produced by radiation, or conduction from an electric arc. In the second, the heat effect is produced within the metal itself by the resistance offered to the passage of the current through it. Whilst the induction furnace is a really large transformer, in which the molten metal is the secondary.

Of the three classes the first, or arc furnace, is really the only one which has been made a commercial success up to the present in the manufacture of steel, though in refining some of the lower fusion point metals, especially aluminium, the resistance type is used extensively, the best-known being the Rochling-Rodenhauser, or combination, furnace.

Arc furnaces have been used for some years successfully in refining steel in combination with open hearth and converter furnaces, and still are, but it is those that are used for converting cold scrap into casting and ingots that are interesting to us Westerners, away from the big iron centres.

Of these furnaces there are only four makes, according to my mind, which can lay claim to being a commercial success on this continent, and they are the Heroult, the Girod, the Gronwall Dixon, and the Snyder.

The Future is Promising for the Electric

I would like to state that in my opinion, the strides which the electric furnace has made in the last few years in steel and alloy-making is nothing to the developments which are going to take place with electric furnaces in the next few years when this country of ours begins to develop her mineral resources. As water power is abundant in most mineral districts notably copper, zinc, and nickel, power plants and furnaces for at least the first stages of refining will be installed right at the mines, thereby allowing for the removal of the dross right on the spot, with, therefore, the high freight rates to the present smelters on the useless part of the ore saved, and I even think iron ore will be treated the same way. Some of you may be wondering why ordinary smelters are not erected on iron ore properties, and this was done in the early activities, but were discontinued for the following reason: The heat produced by a coal or gas flame will only reach a certain maximum temperature of 1,700 degrees centigrade, however much developed, and as this was found not hot enough to refine ore from many fields, it was found necessary to mix the ores from different places in order to properly refine it, and, as this required much shipping of ores, it was found best to ship it all to certain centres and have the smelter there. This state of affairs does not affect the electric furnace at all, as your range of temperature with an arc handled through slag is so tremendous, whilst, as said before, the resistance type furnace can be used for the low fusion point metals; also ores containing 3 per cent. of titanium are not accepted by smelters, but these will be able to be utilized now.

General Costs

Perhaps before finishing it would be well to mention a few words as regards general costs. You will notice I have kept away from this as much as possible, as if I erred one way the furnace builders and sellers would be after me and if the other way, the purchasers of steel castings would be equally wrathy; whilst if I told the truth, both sides would be after my blood. Nevertheless, with a modern three-phase furnace the costs per ton for reducing cold scrap to a good grade of steel, and allowing time to make an analysis before pouring, would be:

Electric power, 750 kw. at ½c.	$ 3.75
Electrodes, 20 pounds at 15c pound	3.00
Refractories	2.50
Slag material	.70
Labor	2.00
Making a total of	$11.95

Whilst with a single-phase furnace it can be done for:

Electric power, 600 kw. at ½c.	$3.00
Electrodes	1.25
Refractories	2.00
Slag material	.70
Labor	1.80
Making a total of	$8.75

These figures, I am afraid, will not agree with any costs you may see printed, as they are up to date. Any figures which I have come across must have all had their calculations based on before-war prices.

Gravity Carriers Reduce Labor Cost of Handling Building Materials

AUTOMATIC gravity carriers have been found useful in construction work to save time and money. The following description of a piece of work on which they were employed indicates to what extent the labor cost of masonry may be reduced. There were used in the building 300,000 bricks, a large amount of tile, and corresponding quantities of cement and mortar. These materials were received in box cars, where they were loaded on carrier tracks that automatically delivered them to a storage pile, where about 25 per cent. of the bricks were temporarily held, or to the cement storage or to the foot of the hoist. The bricks and tiles were transferred to the elevator platform, raised to the required level, and again placed on carrier tracks that delivered them on the bricklayers' scaffold, distributing them as required.

The end of the track was carried into the side door of the box car, and from that point the track was run in straight or broken lines, or curves, as required, and on a light down grade to any required point in the yard, and delivered rapidly an intermittent or continuous stream of materials that moved by gravity alone, without supervision or attendance, and required only that the materials be put on and removed by hand.

The tracks are very light and flexible, and the sections are easily connected together and supported on blocking or light trestles at frequent intervals. They can be shifted easily and passed over or under each other wherever they intersect. On this job about 400 lineal feet of conveyor track was used, and it was installed at an erection cost of about 1 cent per foot.

Small panels of thin wooden longitudinal boards connected by transverse cleats on the upper side, and called pallets, were provided to receive the loose materials. On one of them five or six cement bags were piled, or about 18 common bricks, in two tiers, and the pallet, being released, would rapidly chute down to the end of the track or until removed by an attendant. The light pallets would then be returned for another load, and so on.

Boxes or hods of mortar and loads of brick were delivered to the foot of the elevator, hoisted, and transferred to a conveyor running along the outside of the wall above the suspended bricklayers' scaffold, where sufficient helpers were stationed to remove the bricks and mortar as they arrived and were needed by the bricklayers. In this way all carrying of mortar or bricks by hand or on cars was eliminated and the labor force greatly reduced.

Dam for Port Moody's Water System

The city of Port Moody, B.C., has started construction work on Cypress Lake dam, at the outfall of Noon Creek, which will complete the waterworks system installed last year. The dam will be located 2,700 feet above sea level, will be from 10 to 12 feet in height, and will impound from 40 to 50 feet of water. The approximate cost is placed at $1,800, and the work is being done by day labor. Engineer J. H. D. Kilmer, of Port Coquitlam, is now engaged in surveying the watershed area.

The United States Department of Agriculture have issued Bulletin No. 537, containing the results of physical tests of road-building rock in 1916, including all compression tests. The rocks tested include samples from points throughout the United States; also from Canada, Porto Rico, and Cuba.

Proper Location and Design of Roads

Bulletin of U. S. Department of Agriculture Outlines General Rules—Two Objects: the Convenience of Traffic and Economy of Public Funds

BEFORE undertaking a discussion of the fundamental principles underlying the proper location and design of a public road in detail it is desired to emphasize the all-important facts that for a particular road the best and most economical location depends largely upon individual judgment, and that well-balanced and experienced judgment regarding the relative importance of the various details involved is a much more valuable asset in undertaking to locate a road than mere technical skill in handling surveying instruments. No knowledge gained from books alone can give that complete grasp of the relations existing between a public road and the community it serves which is so necessary if the location and design of the road are to secure the greatest possible good from the money expended.

In locating or relocating a public road the prime considerations should be, first, the comfort and convenience of the traveling public which it is intended to accommodate; and, second, the economy of public funds. The first consideration fixes the general location of the road, and limits such details of design and layout as affect the safety and comfort of travelers. The second should control the detailed working out of a location to suit the topography or surface layout of the region through which the road passes, with due regard for such features of the design as affect the cost of construction, of maintenance, and of hauling over the completed road.

Convenience of Traveling Public

The comfort and convenience of travelers require, first, that the road pass conveniently close to the dwelling places of those for whose particular use it is built; second, that it be free from dangerous curves and grades and sufficiently wide for safe travel; and, third, that the surface be such as to remain reasonably firm and smooth and to become neither very dusty nor very muddy under any combination of weather and traffic conditions. The extent to which any particular road must meet these requirements depends, of course, on the state of public sentiment in the community which pays for the road. But in most communities it is safe to assume that the standards of excellence as regards the accommodation demanded of public roads will be raised rather than lowered. Due foresight, therefore, should be exercised in working out the location and design of a road, so that later improvements, such as reducing grades, increasing the width of the traveled way, or constructing a better surface can be made without the necessity of making expensive changes in the location or otherwise wasting any considerable part of the work already accomplished.

General Rules Governing Location

A few general rules regarding the location and design of public roads may be stated briefly, as follows:

1. Avoid sharp curves in the road, because such curves are a menace to traffic. On light grades and level stretches the location should be preferably such that a traveler may see at least 200 or 300 feet ahead from any point on the road, and on steeper grades this distance should be increased if automobile traffic is to be reasonably safe. Where the view is unobstructed and the grade is practically level, country roads of ordinary width may be curved to a radius of only about 200 feet without seriously inconveniencing traffic, but to safeguard against accidents the radius of curves located on grades should be preferably not less than about 300 or 400 feet, even if the view is perfectly open.

2. Provide ample width for vehicles to pass each other without leaving the traveled way.

3. Bear in mind that if a road ever becomes of any considerable importance its users probably will demand that all the steeper grades be reduced to the lowest maximum that would conform to the general topography of the region which the road traverses.

4. Avoid all unnecessary distance. Aside from the advantages to traffic of a short route, each mile of additional road involves a considerable extra yearly expense for maintenance, and this alone may warrant the extra expense of shortening the route when the road is constructed, provided that the decrease in distance does not materially increase the steepness of the grades.

Land Lines Not Adhered To

5. Regard land lines only in so far as this may be done without decreasing the usefulness of the road or increasing its ultimate cost. The tendency in most rural communities is to locate all new roads along land lines, regardless of the suitability of the route, and this has been responsible for much waste in the past. Not infrequently roads located along land lines have been graded at considerable expense, and abandoned later when the community demanded a more highly improved road with better grads.

6. Give reasonable consideration to the pleasing features of the location. A large part of the travel on most country roads is for pleasure, and the degree of pleasure experienced in driving is largely dependent upon the scenic attractiveness of the road.

7. Plan to avoid the necessity for subsequent changes in location. Such changes nearly always work hardship on some of those who have built homes along the road.

The actual procedure of laying out a road should be controlled very largely by the lay of the land which the road is to traverse. Where the country is comparatively level, for example, practically the whole problem, aside from proper drainage, may be to determine a reasonable balance between the desire to avoid unnecessary damage to farming land and the purpose to secure a reasonably direct route over good ground.

Circuitous or Diagonal Routes

One of the most common problems in laying out a road in level country is to decide between continuing a circuitous route around cultivated fields or along rectangular land lines, and establishing a new diagonal route across the fields.

In mountainous regions, on the other hand, the problem may be to fit the road to the contour of the country, regardless of land lines, cultivated fields, and all other considerations except grade, drainage, and line.

In general, the proper location and design of a road involves: (1) Determining its controlling points—that is, fixing its general route with reference to certain points which the road must pass through; (2) surveying a route which passes through the controlling points and is otherwise adapted to the lay of the land; (3) a study of the drainage situation; (4) preparing such plans and drawings as are necessary for proper construction and a complete record.

Controlling Points

Such features of the locality as gaps through ridges, exposure to the sun, narrow stream crossings, and suitable points for crossing railroads (preferably by means of overhead bridges or under passes), together with the necessity for connecting up with certain centres of population, usually will serve to fix the location of a road within fairly definite limits. For important roads these controlling points are determined by careful inspection of all possible routes.

The Survey

The care which should be exercised in making a road survey necessarily must depend upon the importance of the road and the amount to be expended in its improvement. An ordinary farm road, for example, usually requires no survey other than lining it by the eye between the controlling points. Some unimportant public roads may require very little more than farm roads in the way of a survey, but if any considerable amount of grading or other work is to be done, either at the time the road is located or later, the survey should include all instrument work necessary to insure that the work will be done economically.

The purposes of a survey are (1) to determine accurately the topography or lay of the land, so that the location may follow the route which presents the fewest obstacles; (2) to fit the grade line to the ground surface, so as to keep down the amount of grading necessary; (3) to balance cuts and fills, so that whatever grading is done will be to the best possible advantage; (4) to line up the road and provide stakes for controlling the work; (5) to obtain data from which proper plans may be prepared and an estimate of cost made; (6) to provide a record that will prevent subsequent contentions among landowners regarding the original location of the road. While the importance of all these purposes is apparent, frequently it is not realized that they cannot be accomplished except by means of a careful survey, and that such surveys can be made only by experienced men who have been trained especially for such work. Farmers and business men generally are inclined to underestimate the amount of skill required to make a road survey properly, and their influence has been responsible in the past for much bungling and for uneconomical road work for which they have had to pay in heavy taxes.

First Consideration Is Drainage

Effective drainage usually should be the very first consideration in connection with the location and design of any road. This statement requires no explanation, because the action of water in changing clay into mud and in causing all kinds of soils, except sand, to give way when a load is applied, is familiar to every person living in a humid climate. The following summary supplies a few suggestions as to how water may best be removed from a roadbed:

1. The road surface should be crowned so as to shed water off to the side ditches as rapidly as it falls on the road.
2. Whenever the road is in an excavation, suitable side ditches or gutters should be provided along the sides, so that the water may be conducted to some point where it may be turned off from the road.
3. Where it is impracticable to construct side ditches that will carry the required amount of water without washing, paved gutters should be employed.
4. If the material composing the roadbed consists of springy earth, some form of underdrainage is essential. A line of farm tile laid to proper grade under each side ditch is, in general, the most satisfactory way of securing adequate underdrainage.
5. Culverts or bridges should be constructed wherever it is necessary to carry water across the road.
6. Avoid turning water from one intersecting road down the side ditches of another. Also avoid draining adjacent fields into the side ditches.

Revisions in Timber Mill Practice

New Features Incorporated in Amendments Recommended in Recent Report Covering Mill Construction Specifications

A COMMITTEE of the National Fire Protection Association appointed to submit a report on the uses of wood in building construction, recently submitted its findings. The report, although not finally approved by the association, and therefore not to be interpreted as its standard as yet, contains new features dealing mainly with the question of decay of wood and the calculations of strength of timber. In the following paragraphs are some of the suggested requirements regarding the use of timber:

Floors

(a) The floors shall have the least possible amount of openings, and these shall be protected in an approved manner.

(b) The floors shall be not less than 3 inches (nominal) splined or tongued and grooved, plank covered with 1-inch (nominal) flooring laid crossways or diagonally. Top flooring shall not extend closer than ½-inch to walls to allow for swelling in case the floor becomes wet. This space shall be covered by a moulding so arranged that it will not obstruct movements of the flooring.

Note.—Corbelling of brickwork under floor planks is recommended to take place of the above mentioned moulding.

(c) If laminated floors are used, at least two laminations at the wall shall be omitted until after glazing and roofing have been completed.

(d) Two thicknesses of water-proof paper or felt with sealing compound (but no asbestos) shall be laid between planking and the top flooring, and shall be turned up at least 3 inches around the posts and at the sidewalls. A counter-flashing of galvanized iron or a base-board nailed in place with the joint between it and the floor covered with a moulding shall protect the upper ends of the water-proofing.

A fairly smooth surface shall be provided before any water-proofing is laid, and the felt or paper shall be laid breaking joints and mopped with a water-proof sealing compound. The top flooring shall be laid immediately following the final mopping.

Note.—It is recommended that the floors shall have a pitch about 1 inch in 20 feet to scuppers provided at the floor level, number and spacing to meet the approved requirements.

(e) Where plank floors are laid flat the boards shall be two bays in length if possible laid to break joints every four feet.

(f) Laminated floors consisting of planks 6 ins. to 8 ins. wide set on edge close together and spiked at about 18 in. distance with 60 penny nails shall have the joints broken in such a manner that no continuous line will occur across the floor and shall not be spiked to the supporting girders in order to avoid movement in the girders at the walls due to expansion which may be caused by dampness. The joints between the planks of a laminated floor shall be perfectly tight.

(g) All girders or floor beams shall preferably be single stick timbers, but if double stick timbers are used, they shall be properly bolted together and contact faces shall be treated to prevent decay.

(h) Floor timbers shall not be less than 6 inches (nominal) in either dimension.

Note.—In the determination of the dimensions of the floor beams special attention shall be paid not only to actual loads to be superimposed, but also to the factor of impact or vibration of machinery.

(i) In the calculation of the strength of beams and columns, the permissible stresses established in the following table shall be used and the net cross section of timbers and not the nominal section shall be considered.

Working Unit Stresses for Structural Timbers Used in Dry Locations

	Tension.	Shear.	Compression with the Grain.	Compression across the Grain.
Fir, Douglas—				
Dense grade	1,600	100	1,200	350
Sound grade	1,300	85	900	300
Hemlock, eastern	1,000	70	700	300
Hemlock, western	1,300	75	900	300
Oak	1,400	125	900	400
Pine, eastern white	900	80	700	250
Pine, Norway	1,100	85	800	300
Pine, Southern yellow—				
Dense grade	1,600	125	1,200	350
Sound grade	1,300	85	900	300
Spruce	900	70	600	200
Tamarack	1,200	95	900	350

(j) Wall plates or boxes of sufficient area and of an approved self-releasing type shall be provided at the ends of floor beams where they rest on walls.

(k) Where girders meet at the columns they should be fitted around them or butted up close to them. The ends of beams shall be held in place by steel or iron straps spiked, bolted or lag screwed on their sides unless the post caps have sides projecting upwards which can be lag screwed to the beams.

(l) Where intermediate beams are found necessary for the support of a floor they shall rest on top of the girders. Where steel or iron hangers are absolutely necessary the ends of beams shall be fitted in as well as possible and any interstices between beams fitted together shall be filled in with a preservative compound.

(m) The width of floor bays depends on the layout of the floor, the loads to be carried and the arrangement of the sprinklers; it shall be not less than 6 feet between the centers of the beams.

(n) All exposed woodwork shall be planed smooth.

(o) Pipes or tight-fitting conduits extending through floor shall be provided with metal thimbles and shall be made watertight to a height of 3 inches above floor.

(p) Cellar floor should be of cement or tar concrete laid on a suitable foundation of cinders or broken stone. The cement concrete shall be properly water or damp-proofed as the conditions may require.

Note.—Creosoted wood blocks, embedded in pitch or asphalt, may be used as finish flooring over concrete.

Posts

(a) Posts shall be proportioned in size according to the loads they will carry, but their cross-sectional dimensions shall not be less than 8 inches. All corners to be rounded or champfered. In the calculation of the strength of posts the net cross section shall be considered.

(b) They shall be super-imposed throughout all storeys on metal post caps with brackets or shall have ends connected by properly designed steel or iron caps, pintle and base plate. Wood bolsters may be used to support roof girders only.

(c) Posts shall never rest directly on floor timbers.

Quality and Kind of Timber

(a) The structural timber used shall be free from any form of decay. Sap stain, where the timber is otherwise sound, shall not be considered a defect.

(b) For any defects in limited number or size a corresponding decrease shall be made for the allowable stresses used for the calculation of the strength of timber.

(c) Rough sawed timber shall not be more than ¼-inch and dressed timber not more than ½-inch scant the nominal size.

Note.—The following specifications for timber are given herewith for general information and are recommended as good practice.

Quality.—Girders or beams and posts, when made of southern yellow pine or Douglas fir, shall conform in quality to the specifications for "Dense Grade Pine," adopted by the American Society for Testing Materials (A. S. T. M. Standards 1916; serial designation D 10 to 15; paragraph, General Requirements; pages 515 and 516) and by the American Railway Engineering Association (Bulletin 189; September, 1916; page 78); and girders or beams and posts of oak shall conform to the requirements of oak timbers adopted by the American Railway Engineering Association (Manual of Recommended Practice, 1915, pages 641 and 642); all definitions in the specification referring to oak timbers to refer to standard definitions in this same manual pages 631 to 640 inclusive.

Grade.—Girders or beams of southern yellow pine or Douglas fir shall show not less than 85 per cent. of heartwood on each of the four sides measured across the sides anywhere in the length of the piece. In Volume 1 shall not have sound knots greater in diameter than one-fourth the width of the face on which they appear—maximum knot 1½ in. Shall not have in Volume 2 sound knots greater in diameter than one-half the width of the face on which they appear—maximum knot 3 inches.

The aggregate diameter of all knots within the center half of the length of any face shall not exceed the width of that face.

The diameter of a knot on the narrow or horizontal face of a beam is to be taken as its projection on a line perpendicular to the edge of the timber. On the wide or vertical face, the smallest dimension of a knot is to be taken as its diameter.

Round or ring shakes shall not occupy, at either end of the material, more than one-fourth the width of green material, nor more than one-third the width of seasoned material.

Any combination of checks or shakes which would reduce the strength to a greater extent than the allowable round shakes will not be permitted. Shakes shall not show on the faces of either green or seasoned timber.

Shall not have diagonal grain with slope greater than one in twenty in Volume 1.

Posts or columns shall not have sound knots greater in diameter than one-third the least width of the column—maximum knot 4 inches. Shall show at least 85 per cent. of heart on each of the four sides measured across the sides anywhere in the length of the piece.

Floor Planking.—Floor planking of southern yellow pine or Douglas fir shall conform to the grade "Merchantable" as defined by the timber rules of the Southern Pine Association, January 1, 1917.

For buildings where high humidity is maintained, all floor planks should conform to the grade "Merchantable," but they should be all heart, no sap should be permitted.

Durability

(a) The decay of wood is caused by vegetable growths called fungi, which thrive in wood in damp, poorly ventilated locations. The prevention of decay in mill buildings can be accomplished by the elimination of excessive moisture, which may be brought about by thorough ventilation or heating of all portions. Special care should be given to the design, rot proofing and selection of lumber to be used under moist conditions.

(b) Dry lumber should be used wherever possible, and should be well protected from the weather after delivery at the site. The use of green or partially dried lumber, or lumber wet by rain, snow or other causes, may create conditions favorable to rapid decay. This is particularly true of lumber in large beams or that to be used in laminated floors, under which conditions it will dry out slowly.

(c) Girders or beams which rest in masonry walls should not be sealed in; air space of at least 1½ in. shall be provided all around the end to allow proper ventilation.

(d) Two brush coats of hot coal tar creosote or other suitable preservative applied to the ends of thoroughly dried timbers will assist materially in preventing decay if conditions are not too moist.

Note.—Do not rely upon brush treatment where timbers are to be used in damp or moist locations.

(e) Ends of girders or beams when resting on metal plates shall have the bearing surface protected by a piece of creosoted saturated felt or paper.

(f) Creosote or other preservative compound shall be applied also to the ends of columns between floors.

(g) The timbers for a mill constructed building shall be protected from moisture during construction and no paint or finish of any kind shall be applied to it before it is dry, preferably one year after the building is completed.

(h) In very exceptional cases, the antiseptic treatment of the entire structure may be desirable. This should not be done without consulting with a competent expert in the treatment of wood.

(i) Care should be taken if plaster is applied to timbers which are to be used in a dry location to have the timber thoroughly dry before its application. In cases in which such coated timbers are to be used in a moist location, it is desirable to use timber that has been thoroughly impregnated with a satisfactory wood preservative.

(j) The plaster shall be porous to permit circulation of air.

Aerodrome and Flying School for the Coast

The favorable climatic conditions to be found in the lower mainland section of British Columbia have impressed the Imperial Munitions Board with the suitability of the Vancouver district as an ideal location for an all-the-year-round flying school and training grounds for the Royal Flying Corps. Two sites for big aerodromes have already been secured on the Fraser Delta, one comprising 275 acres on Lulu Island and the other 300 acres near Boundary Bay. The former will first be developed, many hangars being built to house the scores of flying machines of various types, from the military tractors to the swift, high-speed scouting machines. The hangars, together with the buildings necessary for the housing of members of the aviation corps, will in themselves constitute a good-sized village. The work is being carried out by Bate & McMahon, of Ottawa, Ont., under the supervision of Col. R. S. Low.

Suggested Bridge Tender Forms

The Ontario Department of Public Highways has just issued a pamphlet embodying suggestions regarding the necessary forms and data to be supplied by municipalities when calling for tenders and preparing contracts for steel bridges. Permissible types of notice to contractors, specifications, short form of contract and surety form are included. In using these suggestions the department urges that specific requirements should be stated for each bridge, and that care should be exercised in selecting various alternatives permitted by the general specifications.

New Firm to Handle Contractors' Supplies

Messrs. L. P. Burns and A. R. Roberts, both of Toronto, have formed a partnership under the name of Burns & Roberts, Mr. Burns is the head of the Burns Cement-Gun Construction Company, of Toronto, and Mr. Roberts has been acting as the Canadian representative of the Chapman Valve Manufacturing Company, of Indian Orchard, Mass., and of the Cement-Gun Company, Inc., of Allentown, Pa. The new firm will have their offices in the Bank of Hamilton Building, Toronto, and will handle contractors' supplies, reinforcing material, valves, factory equipment,

Practical Hints for the Contractor

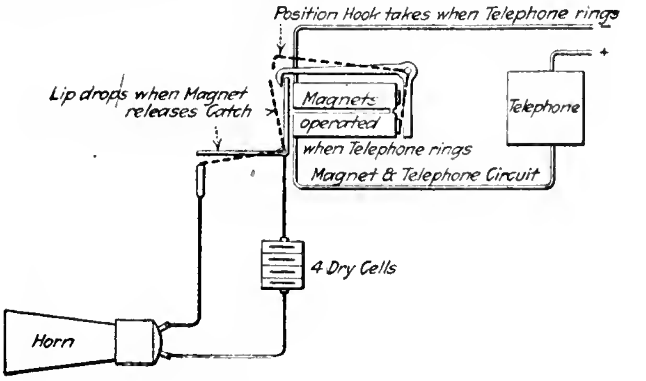
that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Pulling Back Steel Sheet-piling and Re-driving Overcomes Crawling

FOR the construction of a 5,200 ft. retaining bulkhead at Jacksonville, Fla., U.S.A., Wemlinger heavy steel sheet-piling in lengths of 24½ to 37 ft. was used. In driving it was found that not unfrequently the toe of the piling would encounter a peak of rock, a sunken log, or other obstruction, and would be deflected in or out from a straight line. This deflection would obviously shorten the bottom length of the line of piling and cause the crawling ahead of the tops. This tendency for the tops of the piling to lean forward caused considerable trouble, necessitating the employment of various artifices to pull it back. One ingenious method of maintaining a straight line against the intrusions of obstacles on the bottom was developed. After several such obstructions had been encountered, it was discovered that the trouble could be overcome by ceasing to drive a pile the moment it showed signs of deflecting, pulling it back up until it stood plumb, and interlocking and driving several piles ahead of it and past the obstruction. This gave a strong guide for the partly-driven pile, and it could then usually be driven on to grade without any shortening of the bottom line.

Automobile Horn Operated by Telephone Calls Men Out on Construction Job

THERE is usually a telephone on a construction job—and it is often a great bother to the time-keeper or material clerk to have constantly to go out on the job and find the superintendent or the person wanted to answer a call. If the calls are long-distance ones, the person must be summoned im-



Electromagnet in telephone circuit automatically sounds horn when bell rings.

mediately. An easy way of getting out of the difficulty is described by a writer in Engineering News-Record. The trouble is easily solved by putting on the outside of the shanty a Klaxon automobile horn operated by a push-button near the telephone. Give the men likely to be called a particular buzz, such as two short or three long. In this way they can be found in far less time and with far less trouble than by sending someone after them.

This scheme was adopted where the shanty was across a busy street from a ten-storey building that was being erected. In spite of the fact that there was much automobile traffic using similar horns in the street, the distinctive call repeated a few times invariably brought the man wanted. The horn cost $2.50 second hand and required four dry cells for its operation.

Another arrangement, illustrated herewith, has a horn which automatically sounds when the telephone rings. In this case the office was situated on the hill; and when the telephone rang, the bell could not be heard unless someone were near it. An electromagnet similar to that ordinarily used in a call bell was placed in the telephone circuit, so that when the telephone rang the action of the magnet raised a latch that released a "lip," or drop. When this drop fell, it automatically closed a circuit in which a Klaxon horn was wired up with four dry cells. This circuit, of course, would remain closed, and the horn would continue to sound until someone came and put up the drop. The general arrangement is shown in the sketch

At night, and when there was no one on the work, it was a simple matter to disconnect one of the wires and break the circuit, eliminating the danger of exhausting the dry cells in case the telephone should ring when no one was there to put up the drop. As the work was down in the river bed and some distance from town, there was no chance of confusing the signal with other automobile horns.

U-Bolts in Road Support Finishing Bridge at Street Intersections

IF the bridge used in the construction of concrete pavements is of a definite fixed length, difficulty is often encountered at street intersections in supporting the bridge or in improvising a bridge from which to work. Manhole tops are sometimes utilized, one end of a plank resting upon them, the other end resting upon the gutter or curb. If satisfactory bridging is not arranged beforehand, workmen are tempted to walk in the concrete after it has been struck off, or finishers, in too great a hurry to wait until the struck-off surface has sufficiently hardened, will place a board directly upon the new concrete and, and kneeling thereupon, proceed with their finishing operation.

The following method has been found very satisfactory to eliminate these difficulties and unworkmanlike methods of placing street intersections.

About a dozen U-bars, ¾ in. round and pointed at the ends, should be applied for each job. Several of these should be driven across the intersection along the line of prolongation of the curb or gutter, as the case may be. Two by twelve inch planks are then laid across the tops of the U-bars to form a runway upon which the bridge may ride across the intersections. After the bridge has passed over this the planks are removed, the U-bars are pulled out of the concrete, and the holes filled with grout.

Portneuf Hydraulic Co. Has Installed Initial Unit

La Compagnie Hydraulique de Portneuf, Limitee, have recently completed the installation of the first unit at their power house on the St. Ann's River at St. Alban, Que. Several interesting features from an engineering standpoint were encountered in the building of the main dam, power house, and excavations, due to rock formation.

The first dam across the river was completed in 1914, but owing to faulty construction was carried away by the high water. The company was reorganized, and the new concrete dam completed later in 1914. In the spring of 1915 the new company decided to install the first unit, and awarded the contract for the head gates, excavation, and building of power house to Messrs. Archambault & Conway, of Montreal, who completed the contract in September, 1915.

Considerable difficulty was encountered owing to the heavy rainfall during the spring and summer, which necessitated working under water the greater part of the time to allow of the installation of the draft tubes. After a heavy rainfall of several hours' duration the level of the river would show a rise of seven to eight feet, which delayed the progress of the work. Owing to the heavy rush of water much small rock was washed into the draft tube excavation after a rainfall, which again delayed operation.

The Turbine Equipment

The water wheel equipment consists of one vertical turbine unit complete. This wheel is of the well-known improved Samson enclosed turbine 35 in., with steel plate case and draft tube. The turbine is furnished with water through a 6-ft. diameter intake pipe. The turbine is controlled by one 6,000-ft. pound Lombard oil pressure governor of the Erie Canal Type.

The unit develops 550 horse-power when operating at a speed of 300 revolutions per minute, the head varying from 35 to 48 feet. The efficiency of the unit when operating under these conditions shows approximately 89.99 per cent.

A 6-ft. diameter butterfly valve, complete with the necessary hand-operating mechanism, is situated in the intake pipe, so that the water can be completely and conveniently closed off from the turbine unit.

The drawing herewith gives a general description of the installation.

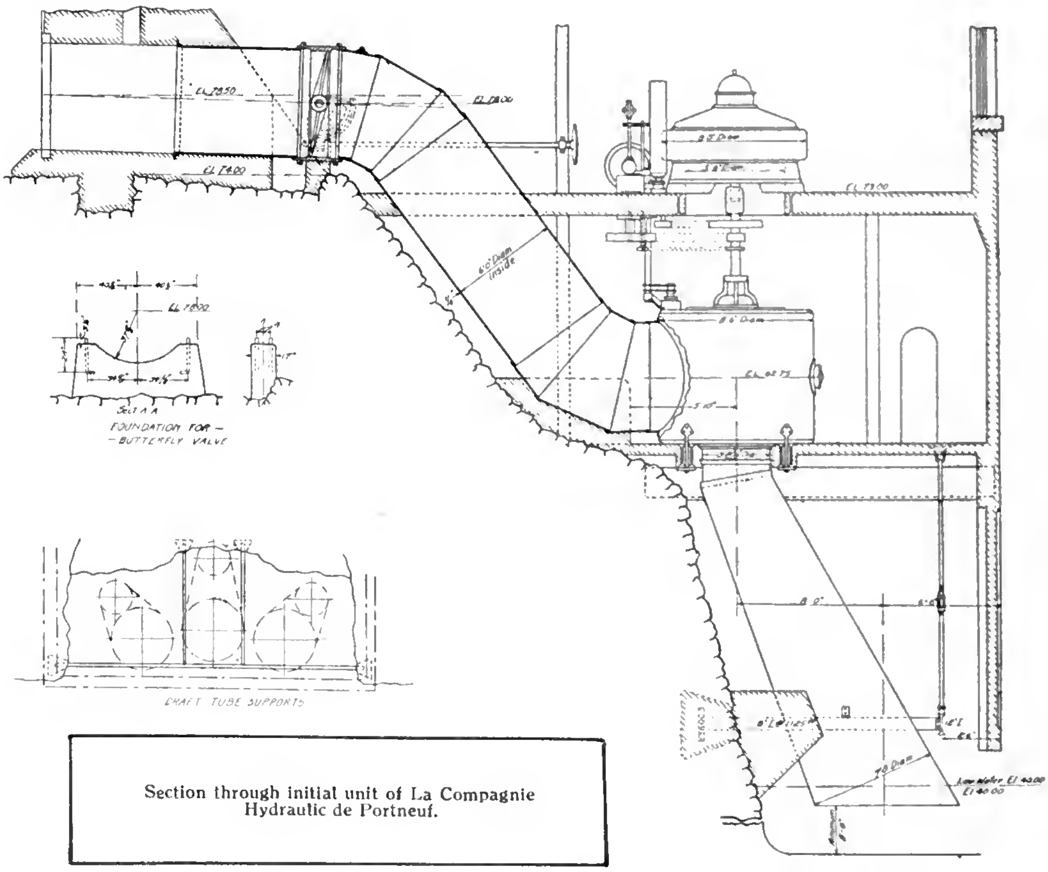
Electrical Apparatus

The contract for the electrical apparatus and its installation was awarded to the Engineering Company of Canada, Montreal, and consists of the following:

1 size 24S, 500 kv.a., 300 r.p.m., 6,600-volt, 3-phase, 60-cycles vertical alternator for direct coupling to vertical water wheel shaft.

2 twenty-two kw. type R., vertical, direct current exciters, 125-volt, 950 r.p.m.

The exciter shafts extend through the power-house floor and are driven by pulleys on the water wheel shaft. In this manner all accidents are avoided, as it leaves the floor clear from revolving belts.



Section through initial unit of La Compagnie Hydraulic de Portneuf.

The lines of the company extend to the villages of St. Alban, St. Marc, Des Carrieres and Deschambault, Que. The transmission line voltage is 6,600, which is stepped down to 2,200 and 550/110 volts at St. Marc. for light and power and 110 volts at St. Alban and Deschambault.

The consulting engineer for the company is Mr. De Gaspe Beaubien, Montreal. The water wheel equipment was manufactured and supplied by the William Hamilton Company, Ltd., Peterboro, Ont.; the electrical apparatus was manufactured by the Electric Machinery Company, Minneapolis, Minn., and supplied and installed by their representatives, the Engineering Company of Canada, Transportation Building, Montreal.

Trade Publications

Steel Hardening—Booklet distributed by the Stroh Steel-Hardening Process Company, Pittsburgh, illustrating and describing the company's method of producing wear-resisting steel castings.

Air Compressors.—Bulletin K-302, 16 pages, illustrating a line of steam-driven, straight line, single stage air compressors manufactured by the Canadian Ingersoll-Rand Company, Ltd., of Montreal. The type of machine described is designed to cover the field of those requiring compact, self-contained units of small and medium size for service in shop, foundry, mill or electrical plant, etc. Automatic splash lubrication, dust-proof construction, "Circo" silent leaf valves and quick convertibility to belt drive are among the leading features of the design dwelt upon in this publication.

Mainly Constructional

East and West—From Coast to Coast

At a recent meeting of the council of Welland County, Ont., it was decided to add 25 miles to the county good roads system, distributed among the various municipalities.

Welland's building figures continue to keep well ahead of last year. During the month of June permits to the value of $22,530 were issued, as compared with $13,260 in the same period in 1916. The total for the first six months of the year is $155,675, as against $112,456 during the corresponding period last year.

It is stated that a group of financiers propose to erect a $10,000,000 iron and steel plant with the necessary coking ovens, and also a shipbuilding plant, in the province of British Columbia. According to Industrial Commissioner J. R. Davison, of Vancouver, there would be 3,000 men employed in such a plant, and as many more men in new mines to be opened for the supply of ores. The company would install blast furnaces and make ship plates.

Mr. W. A. McLean, Deputy Minister of Highways for the Province of Ontario, announces that the counties of Huron, Bruce, Kent and Ontario, have now adopted good road systems under the provisions of the Ontario Highways Act, while Norfolk, Grey, Renfrew and Dufferin have passed by-laws preluding an early adoption of the system.

Barton Township has decided to enter into an agreement with the city of Hamilton, Ont., for a water supply, in accordance with a resolution passed last March by the city council. Under this arrangement the city will supply Barton residents with water by meter at fifteen cents per 1,000 gallons. Tanks will be used for the purpose of distribution.

Building permits issued in the city of London, Ont., during the month of June number 99, and are valued at $150,230, as compared with 135 permits valued at $98,105 in the same month last year. For the first six months of the year the total is 453 permits valued at $409,150, as against 533 permits valued at $370,710 during the corresponding period in 1916.

Some of Toronto's contracting firms are evidently feeling the effects of the city's efforts to curtail its work and thereby decrease expenses. In this connection the Godson Contracting Company has written to the board of control suggesting that the city undertake more local improvements, or, in the alternative, that the contractors be given a share of the repair work being done by the Works Department.

The building returns for the city of Toronto during the first half of 1917 are very encouraging. For the six months ending June 30, permits were issued to a total value of $3,326,228, which is an increase of $641,919 over the corresponding period last year, when the total was $2,684,309. The figures for the month of June, also, compare favorably with those of the same month last year, the totals being $673,244 and $573,889 respectively.

The work of pouring in the concrete for the storage tanks at the plant of the Saskatchewan Farmers' Co-operative Elevator Company, at Current River, Port Arthur, is now being proceeded with. Construction of the working house is also going on, and the buildings are up one storey high already. The plant will be completed in time for the handling of this year's crop. Barnett and McQueen have about six hundred men working on this elevator.

The Imperial Munitions Board has recently let contracts for two wooden vessels, canal size, to be built on the new industrial area at Ashbridge's Bay, Toronto. The contractors are Messrs. John E. Russell, of the Russell Contracting Company, and John J. Manley, manager of the C. S. Boone Company. The steamers will be constructed of British Columbia fir. In addition to the engines, modern machinery will be installed for hoisting and handling bulk freight.

Representatives from Orangeville and Shelburne recently visited Owen Sound, Ont., to secure the support of the local board of trade and the members of the county council in their recommendation that the proposed provincial highway from Toronto to Owen Sound run by way of Port Credit, Orangeville, Shelburne and Markdale, following the route of the Toronto and Sydenham road. It is proposed to run a branch line from Shelburne by way of Synhampton and Duntown to Collingwood. The petition which is to be forwarded to the provincial government favoring this route was signed by the president of the board of trade on behalf of its members.

The city council of Trail has let a contract to J. A. Broley & Company, of Fernie, for the construction of a sewerage system, the tender price being $24,650. Two other tenders were submitted—one at $28,165 and the other, $38,035. Five tenders in all were received for the new waterworks system to be laid down, Broley & Company's offer of $44,990 being the lowest, and a Vancouver firm topping the list at $76,819. All were considered too high and it was decided to call for new tenders, first modifying the specifications by eliminating the Violin Lake reservoir and conduit pipe line, which were responsible for the high figures. A Denver, Col., firm of brokers offered 93½ and accrued interest for the $80,000 issue of waterworks bonds, and their bid was accepted.

Personal

R. B. Freeland, for a number of years engineer with the Granby Mining Co. at Grand Forks, B.C., has received from the provincial government the appointment of district engineer of the southern mineral survey district, with headquarters at Grand Forks. He is a graduate of the Camborne school of mines, Cornwall, England, and one of the most competent mining engineers in this province.

Obituary

Capt. Frederick Pitts is officially reported to have died of wounds received in France. Capt. Pitts, who was formerly in the contracting business, was well known in North Toronto. He went overseas last September and was stationed in France for about eight months before his death.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Barton Township, Ont.
Tenders received by the deputy minister, W. A. McLean, Department of Public Works, Toronto, until noon, July 16, for the construction of a waterbound macadam road on Garth Street for the Provincial Government. Plans, etc., at office of the Deputy Minister and Clerk's office, 422 Concession Street, Mount Hamilton.

Grandmere, Que.
Town Council contemplates installation of pumps, etc., costing $10,000. Engineer, Charles Gelinas.

Kent County, Ont.
County Council have passed by-law for a 250 mile good road system. Clerk, Jonas Gosnell, Chatham.

Montreal South, Que.
Tenders received by the engineer, E. Drinkwater, 23 Lafayette Boulevard, St. Lambert, until 6 p.m., July 19, for waterworks, etc., costing $180,000, for the Town Council.

Owen Sound, Ont.
Tenders received by the clerk, Thomas Willoughby, until July 13 for the construction of concrete curbing and nine-inch tile drain for the Town Council.

Shawenegan Falls, Que.
Tenders will be called for the construction of highway, costing $25,000, for the Town Council. Secretary, J. E. Meunier.

Tenders will be called for the construction of a highway, costing $18,000, for the Town Council. Secretary, J. E. Meunier.

Three Rivers, Que.
City Council contemplate construction of asphalt pavement, costing $20,000. Engineer, Z. Lambert.

Public Works Department, City Council contemplates highway costing $22,000. Engineer, Zep. Lambert.

Toronto, Ont.
Tenders received until July 17 for the construction of sewers on Yonge Street for the Board of Control. Plans, etc., at Works Department. Secretary, Thos. McQueen, City Hall.

CONTRACTS AWARDED

Beauceville, Que.
Joseph Doyon has general contract for concrete sidewalks for the Municipal Council.

Grandmere, Que.
L. A. Beauchemire has general contract for construction of $18,000 macadam road for the Town Council.

Stack & Leger, care of secretary, T. G. Roy, have general contract for laying tarvia on road, at a cost of $8,000, for the Town Council.

Hamilton, Ont.
J. J. Armstrong & Son, 116 Burris St., have contract for sewer for the city of Hamilton.

London, Ont.
The Webster Construction Company, Adelaide and York Streets, Wm. McCracken, 481 Central Ave., and Mitchell & Mohan, Wharncliffe Road S., have contracts for construction of sanitary sewers costing $7,000 for the city.

St. Lambert, Que.
Laurie & Lamb, 42 St. Sacrament St., have general contract for pumping equipment for the Town Council.

Three Rivers, Que.
The Canadian Johns-Manville Co., Ltd., 450 St. James St., Montreal, have the general contract for alterations costing $4,200 to boulevard for the Public Works Department, City Council.

Trail, B.C.
The Alberta Clay Products Co., Medicine Hat, and the British Columbia Pottery Company, have contracts for supply of sewer pipe in connection with water supply and sewage system costing $50,000 for the city. The Trail Mercantile Company have the cement contract.

Railroads, Bridges and Wharves

Oxford County, Ont.
Plans and specifications at the office of the engineer, F. J. Ure, Woodstock, who will receive tenders until noon, July 14, for building abutments and erection of steel bridge for the County Council.

Toronto, Ont.
Tenders close July 31 for construction of extension to Bloor Street Civic Railway line. Works Commissioner, R. C. Harris.

Vancouver, B.C.
Plans have been prepared for a freight shed, 1,005 feet long, slow-burning construction, to be erected by the Department of Public Works, Dominion Government. Secretary, R. C. Desrochers, Ottawa.

Windsor, Ont.
Tenders are being received by the engineer, Mr. Stillman, C.P.R. offices, London, for the erection of a $30,000 reinforced concrete viaduct for the Canadian Pacific Railway.

CONTRACTS AWARDED

Arron Township, Ont.
James Cole, care of H. Potts, Tara, has general contract for $5,000 steel and concrete bridge for the Township Council.

Bertie Township, Ont.
Philips Chester Johnson, Ridgeway, has the general contract for concrete bridge for the Township Council.

Carleton County, Ont.
A. E. Farley & Co., Banque National, Ottawa, have general contract for bridge for the County of Carleton.

Consort, Alta.
Tenders will be called about July 25 for the erection of a school for the Public School Board. Architect, A. M. Jeffers, McLeod Block, Edmonton.

Dorchester, Ont.
Chas. Collins, Putnam, has general contract for bridges costing $3,000, for the Township Council.

Ontario, Province of
The Sherwood Construction Co., Mail Bldg., Toronto, have contract for grading work from London to Guelph in connection with construction of sidings, bridges, etc., costing $185,000, for the Canadian Pacific Railway, head office, Montreal.

Paris, Ont.
Plans are being prepared for a $7,000 hall for the Salvation Army. Architect, Grig.-G. Miller, Albert St., Toronto.

St. Boniface, Man.
The Dominion Bridge Co., Canada Bldg., Winnipeg, have the steel contract for $250,000 bridge for the Eengineering Department, City Council.

Public Buildings, Churches and Schools

Chatham, Ont.
The Chatham Board of Health and the Kent County Council contemplate erection of a tubercular hospital.

Embro, Ont.
Tenders received by the chairman of the building commission, Dr. R. H. Green, until July 16 for repairs to church for Knox Church. Plans and specifications with the chairman and architect, J. S. Russel, Gordon Block, Stratford.

Montreal, Que.
The High-African-American Episcopal Church will erect a church on Marquette Street.

School Board contemplate erection of school. Secretary-Treasurer, W. Lafontaine, Box 476.

Notre Dame des Neiges-de-Masson, Que.
School Board plan $7,000 school. Secretary-treasurer, A. Mongeot.

Ottawa, Ont.
The Military Hospital Commission, 22 Vittoria Street, contemplate erection of a tuberculosis hospital. Town undecided. Officer in charge, Capt. W. L. Symond.

St. Anne de Bellevue, Que.
The Military Hospital Commission, 22 Vittoria Street, Ottawa, will erect a convalescent home here instead of at St. Anne de Beapre as reported in our issue of June 20. Architect, E. L. Horwood, Public Works Department.

St. Hune de Chicoutimi, Que.
Municipal Council plan erection of a $20,000 wood and brick convent.

St. Hyacinthe, Que.
Fire Department, City Council, contemplate $30,000 brick fire hall. Chair-

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Principal Contents

Reaching Labor's Rank and File

THE British Government has taken vigorous and unprecedented action to get at the cause of their labor troubles by the appointment of a number of Government Commissions on Labor which will endeavor to get at the root of the discontent. England, Scotland and Wales have been divided into eight districts, each to be presided over by a Commission. There is to be a real endeavor to arrive at the feelings of the rank and file of labor with as little formality as may be; to reach the views of the great body of the laboring classes, rather than of those who have been constituted the spokesmen of labor, and who are often inspired by motives not in the interests of those they represent. These commissions are not to advise, but simply to collect facts, and the supposition is that the government, in possession of these facts, will act promptly.

In Canada the solution of the labor problem is scarcely less urgent. Much of the trouble is due to misunderstanding—mutual, without question. Such commissions as have been appointed by the British Government would appear to have great possibilities for good if they can only succeed in winning the confidence of labor to such an extent that the men will talk openly and frankly. Much of the trouble in dealing with labor is lack of appreciation of their conditions and lack of sympathy for their difficulties. It follows that the personnel of these commissions will be a factor upon which final results will depend to a very great degree. That these results should be in evidence at an early date is greatly to be desired, not only that by better co-operation we may bring the war more quickly to a successful close, but that we may have the necessary organization to meet the after results, whether these be days of industrial depression or of an intensified competitive activity. Today all classes are standing together on the battlefields of France inspired by one common ideal. Can they not do likewise when the war is over? Any steps which will lead towards a better mutual understanding between capital and labor are assuredly in the right direction.

Fraser River Jetty Work Completed

ON July 1 the last unit of the jetty work authorized at the mouth of the Fraser River, B.C., was completed by the contractors, Messrs. Marsh, Hutton, Powers Company, Ltd., of New Westminster. The completion of this jetty represents the final investment by the Dominion Government for this year of $500,000 sunk in the waters at the mouth of the Fraser River for the purpose of aiding the currents of the river in carrying out to sea the vast deposits of silt that would otherwise spread over the flats below Steveston and divide the outlet of the river into so many mouths that no definite channel could be relied upon. Now the rushing currents of the river strike this wall of rock and are confined so that they rush on out to sea, carrying along the silt that would otherwise block the channel. This channel wall rests on mattresses of brush, sunk to the bottom by weights, and is about 90 feet wide at the base, tapering to a width of 3 feet at the top, and is built entirely without cement.

There was an application before the Public Works Department this year for a further expenditure of a million dollars to construct two other jetties at the mouth of this river, one on the Steveston side of the river and one on the Canoe Pass side, but the department failed to include the amount in the estimates, on the ground that the heavy war expenditures were drawing on the treasury to such an extent that it was impossible to do further work along this line for some time.

Gas-Filled Windows

THE filling of incandescent lamp bulbs with nitrogen produced an astonishing increase in the illuminating efficiency of the electric lamp. A film of nitrogen about one-sizth of an inch thick adheres to the incandescent "wire" and is the cause of the increased brilliancy of the lamp. The "gas-filled lamp" has revolutionized the lighting industry.

In an article by Halbert P. Gillette, published in Engineering and Contracting, it is shown that the heat resistance of window glass is so slight that if it were not for the films of quiescent air adhering to window panes, the heat losses from windows, great though they are, would be many fold greater. It is also shown that ordinary air has twice the heat conductivity of carbonic acid gas—the gas used in "soda water."

Mr. Gilette accordingly has designed a double window, the space between the panes being filled with carbonic acid gas or any other suitable gas having a low coefficient of heat conductivity. With such a "gas-filled" window, the heat loss would be one-third what occurs with any ordinary single window when the air is still, and only one-fifth of what occurs on a windy day.

Concrete Ships—Why Not?

Success Attending Use of Cement Barges for Many Years Indicates That Similar Construction is Applicable to Ships

THE problem that confronts our country of increasing the merchant marine requires the consideration of every possible method or material of construction. Several prominent engineers have suggested reinforced concrete.

A San Francisco paper mentioned in a recent issue the interesting fact that a local firm of engineers was designing a ship with a length of 330 feet, a beam of 44 feet and a depth of 31 feet, with a capacity of 4,500 tons, to be built of reinforced concrete. This is not something new—a concrete schooner was employed for some years in the north Atlantic coasting trade, having been constructed in about 1898. The London Times mentions a small boat of reinforced concrete built by a Frenchman in 1849 and still in service after a test of 68 years.

Concrete Lighters in Use for Years

The concrete ship is only a further development of the concrete barge, and such craft have been in successful use for years. Concrete lighters have been used for the past six years on Chesapeake Bay, supplying coal and water to dredges, carrying loads of sand and gravel, etc., and the accompanying illustration of a 500-ton lighter on the ways just before launching is typical of their appearance. With such a craft there is no necessity for caulking or painting, the upkeep is small and there is no danger of decay.

Barnacles, moreover, will not collect on a concrete hull.

A concrete barge has been in service on the Welland Canal since 1910 and has seen very hard usage. It has a length of 80 feet, a beam of 24 feet, and is 7 feet deep. It is interesting to note that the walls which were constructed between forms are 2½ inches thick, reinforced with steel rods, yet the barge is used for carrying loads of stone, etc., with conspicuous success.

Since 1910 reinforced concrete barges have been built for use on the various sections of the Panama Canal and their experience has enabled the engineers to develop a very efficient type of vessel. Recently concrete pontoons were constructed for service as landing stages for boats up to 65 feet in length. These pontoons have a length of 120 feet, a beam of 28 feet, and are 8 feet deep. They are very thoroughly reinforced.

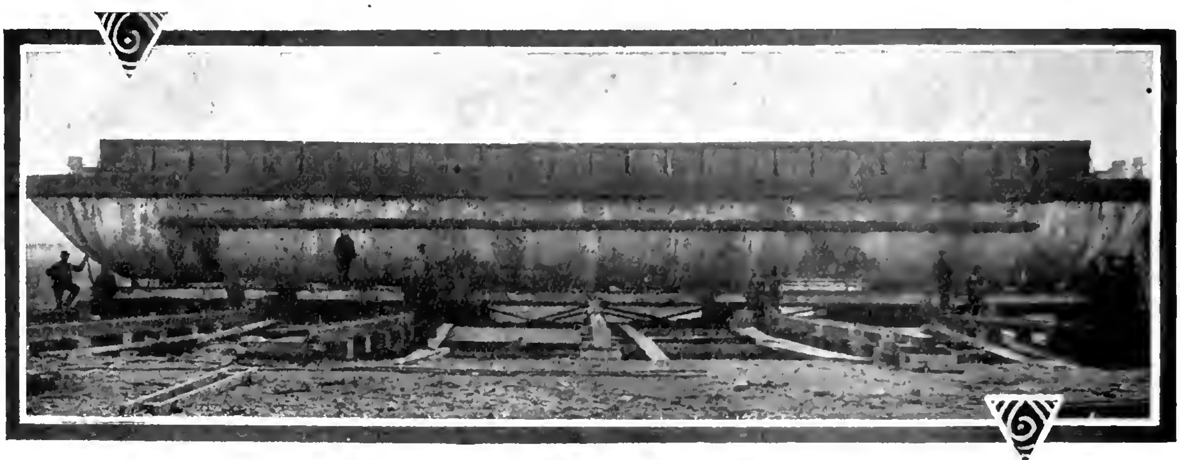
Norway Building Concrete Vessels

Vessels which are more like ships than barges have been built of reinforced concrete in Norway. A report from the American Consul General at Christiania describes a plant at Moss, Norway, where vessels of 3,000 tons displacement are being constructed. The following quotations from the report indicate the extent of the work under way at that time:

"The inventor of this new style of vessel is said to be M. Nicolai Fougner, an engineer, who claims to be able to construct a ship of any size demanded. He is now building a lighter for a mining company at Sydvaranger for the oversea export of iron ore and the import of coal. The vessel, having a displacement of 3,000 tons, is to be ready before the end of the current year. It is stated that these concrete ships can be sailed or engined like other vessels, and experts consider that a new epoch in shipbuilding has arrived.

"The ship, which arrived in Christiania last month, resembles a large barge, and is constructed entirely of concrete with the exception of the ribs, which are of steel. This new method of constructing ships has attracted much attention. The Swedish Minister of Marine, M. Brostrom, one of Sweden's largest shipowners, immediately ordered a lighter of some thousand tons displacement, and he was present when the craft was launched at Moss. He was accompanied by

(Concluded on page 621)



A 500-ton concrete lighter before launching. Courtesy Portland Cement Association.

Sault Ste. Marie Waterworks Plans

A VARIETY of new waterworks schemes for Sault Ste. Marie, Ont., has been submitted for the approval of the Water and Light Commission of that city in a report just completed by Mr. R. O. Wynne-Roberts, M.Can.Soc.C.E., consulting engineer, of Toronto. Mr. Wynne-Roberts was appointed some time ago to investigate means of improving Sault Ste. Marie's water supply and to report on possible sources that would allow an abundance of pure water in sufficient amount to provide for the future natural growth of the city. Mr. Wynne-Roberts made a thorough investigation of the situation and has incorporated his findings in a 95-page report he has just submitted to his clients. Although several possible solutions to the problem are given consideration, the one recommended by the author of the report as being superior for numerous reasons, will provide all the water needed by Sault Ste. Marie for years to come, of excellent quality and delivered to the heart of the city by gravity, to be distributed by pump or retained in a storage reservoir. The capital expenditure and annual maintenance costs for this recommended scheme are both less than the corresponding costs of the four other suggested arrangements.

Present Arrangements

The present waterworks for Sault Ste. Marie is operated by the city, the pumping station forming part of the Great Lakes Power Company's hydro-electric power house on the power canal of the St. Mary's River. Pumpage is by electric-driven centrifugal pump with a water capacity of about 3,000,000 U. S. gallons per day. There are also three steam-driven horizontal, duplex, fire pumps, one having a capacity of about 1,200,000 gallons per day and the other two with each about 1,320,000 gallons per day. The normal station water pressure is about 80 lbs. per square inch and the fire pressure is 110 lbs. per square inch, these pressures in the heart of the city being about 70 and 100 lbs., respectively. The water intakes are located at penstocks No. 4 and No. 6 and in the tail race. There was formerly an emergency connection to the ship canal by means of a wooden pipe, this having been recently removed owing to extensive alterations. A new 16-inch steel main will be laid to re-establish the connection with the ship canal.

The water is delivered to the city through two mains, a 24-inch and a 10-inch. The quantity pumped is measured by means of a pitot tube inserted in the 24-inch main in the pumping station. According to records, the daily consumption for the twelve months of the year ending June 13, 1917, averaged 3,200,000 gals.; the maximum and minimum consumption during the period being 3,823,000 and 2,557,000 respectively. The per capita consumption is considered very high and if the quantity were reduced to normal, the consumption would be about 1,500,000 gals. per day.

The adjoining municipality of Steelton, which in reality forms an integral part of Sault Ste. Marie, and will, in all probability be merged with the latter place in the course of a few years, derives its water supply from wells. Three wells are made use of and the pumping station contains two electrically-driven centrifugal pumps. The overflow water can be discharged into a 650,000-gallon covered concrete reservoir.

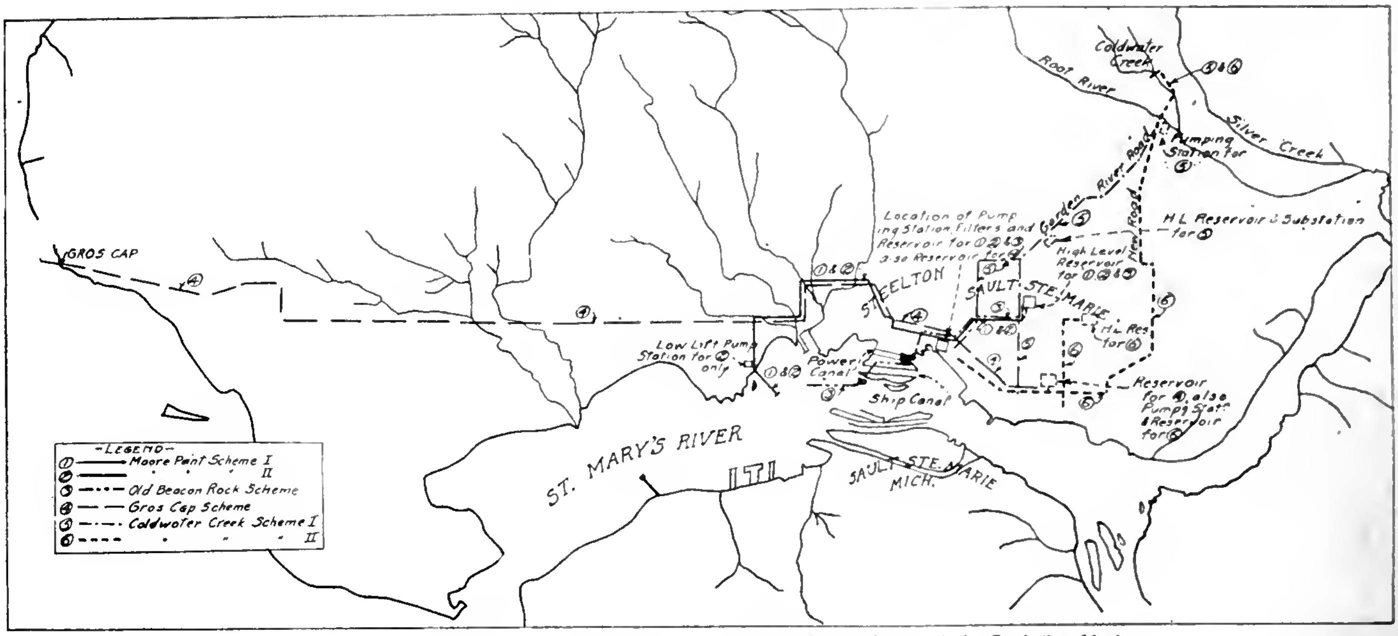
Present Water Supply Polluted

Sault Ste. Marie's water supply taken from the power and ship canal is unsatisfactory in quality owing to the refuse discharged by the vessels plying St. Mary's River, and to undesirable matter from industrial works on shore. It is inevitable under the circumstances which obtain in the neighborhood that this undesirable matter will continue to be discharged into the canal. The only precautions which can be applied are a regular supervision of the process of sterilization which has been carried on since 1913 by the generous use of hypochlorite of lime. The water is examined by the chemist of the Lake Superior Pumping Company and hypochlorite of lime is added according to his directions. Owing to the method of shipping lime in large iron drums, deterioration of the lime takes place when they are opened, and even if the correct quantities are used according to the chemist's directions, the proportion of chlorine is gradually diminished. Unless attention is paid to this, the chlorination will vary. Apart from reasons of cost and reliability of supply, the city is under an obligation to provide a pumping station and to remove the pumps out of the present building. The Great Lakes Power Company is entitled to call upon the city to comply with an agreement to this effect by giving six months' notice. No satisfactory scheme from any source can be devised and carried out in such a short period. It is therefore advisable that the city decide on a new source of supply without delay so as to be prepared.

In submitting his findings, Mr. Wynne-Roberts estimates that the population of Sault Ste. Marie will increase to at least 20,000 by 1931, and if Steelton unites in the meantime, the total population will probably be at least 27,300 in 1931. It is possible, however, that the increment will exceed this estimate and that future industrial expansion will warrant the expectation of a total of 30,000 persons, and provision should be made to meet this contingency. In submitting the schemes, therefore, Mr. Wynne-Roberts lays out programmes sufficient for 30,000 inhabitants. The supply which is figured upon for this population is 3,600,000 gals. per day for normal consumption and 5,040,000 for fire purposes, a total of 8,640,000 gals. per day. These figures are the requirements of the Canadian Fire Underwriters' Association.

Uncertainty as to Artesian Well Supply

As the first possible solution to the Soo's water supply problem, Mr. Wynne-Roberts turns to the possibility of procuring artesian well supply. To summarize the essential conditions of artesian water supply, it may be stated that there must be a deep layer of porous materials for an extensive surface area, through which rain and river water may freely percolate, and a gradient from the hills to induce an underground flow. There must also be a large storage capacity in the gravel, sand and rock to furnish a steady supply during the periods when the rain fall is small, the height of water in the streams is low and the ground surface is frozen or coated with packed snow.



Composite map showing the various suggested schemes of waterworks supply for Sault Ste. Marie.

After a thorough investigation of the geological conditions of the environments of the city and a study of existing wells in the locality, it was found that these conditions are only partially found on the west side and that therefore an ample supply of artesial water can hardly be expected. The prospects on the eastern side are better, but no wells have yet been sunk upon which any reliable data can be based, so that it is not possible to state with assurance whether the prospects for an artesian supply of water are good.

Objections to St. Mary's River as a Source

The St. Mary's River, which naturally suggests itself at first thought as a beautiful source of water, is attractive so far as quantity is concerned, for the volume ordinarily passing down aggregates 30,000 million gallons per day. This river serves purposes of navigation and power, and on this score will doubtless be the scene of many activities in the future. This will render the project of ,locating permanently reliable and satisfactory waterworks intake in the river opposite the city one of great difficulty. There is, however, the even more important question of quality of the water, which is so poor as to make its use for public consumption undesirable. Contamination is chiefly due to boat traffic, which so pollutes the water, especially during the navigation season, as to produce an excessive typhoid death rate. One factor that must be considered is that the currents in the river are never constant from day to day. "Hence the pollution is carried in various directions according to conditions affecting current, and evidence of pollution may be obtained at a certain spot one day and at a totally different place the next. These chance pollutions are amongst the most dangerous to deal with, because, not being constantly there, so to speak, they are apt to lead to a false sense of security and put people off their guard against the time when the contamination is present. It will thus be gathered that use of this water for drinking purposes in its raw state is decidedly not recommended."

Four Schemes Possible on St. Mary's River

In the report, four possible schemes drawing water from the St. Mary's River are suggested, with two possible sites for the intakes. In outlining the St. Mary's River scheme, however, the extreme necessity for ample filtration facilities is pointed out. It is also emphasized that owing to the depth of water in St. Mary's River being shallow, except in or near the ship channel, there are no sites which can be utilized that are free from objections. It is necessary to have a depth of 30 feet or more to insure a permanent supply of reasonably good water. To insure a constant supply it is necessary to safeguard against ice on the one hand and mud on the other.

The four St. Mary's River schemes are known as, Moore Point Scheme No. 1, Moore Point Scheme No. 2, Beacon Rock Scheme, and the Gros Cap Scheme. In the Moore Point Scheme No. 1, there is a submerged crib intake in the ship channel with an intake main of about 1,800 feet to the shore. The water could be delivered by a 30-inch reinforced concrete gravity conduit for about 22,500 feet to a pumping station at the heart of the city, where the filtration tanks and a million-gallon reservoir will be located. Unfortunately the trenches for much of the distance would be over 20 feet deep. A 24-inch main would be used to supply the high level reservoir, the recommended location for which is on the Great Northern Road, north and east of the city, and at an elevation of about 750 ft.

Alternative Moore Point Scheme

Moore Point Scheme No. 2 is intended to avoid the deep trenching. The submerged intake crib and intake main will be the same as in No. 1, but the water would discharge into a screen well and would be raised by a low level pump into a wood stave pipe and delivered to the same site as that in No. 1 scheme. In other respects this scheme is similar to the one just described.

The old Beacon Rock scheme comprises an intake about 1,700 feet west and slightly south of the Canadian ship canal on the east margin of the ship channel. The question of how to obtain a supply of water involves in this case many difficulties since the water front is owned by private corporations and the ship canal has to be crossed by some means or other. As recommended by Mr. Wynne-Roberts, the plan would involve an intake main to St. Mary's Island, a tunnel under the ship canal, a low lift pumping station near the C. P. R. tracks, a cast iron main to near the

Great Lakes Power Company's power house, and duplicate mains connecting to the same site as recommended for the Moore Point scheme; a high level reservoir would be as outlined in the previous paragraphs.

The ideal site for an abundant supply of good water is that at Gros Cap. The principal disadvantage of drawing water at present at this point is the capital expenditure which would be involved in the construction of the trunk main, which would be 13½ miles long to the Andrew Street reservoir, as included in previously outlined schemes. In view of the financial impracticability of undertaking this scheme at the present time no cost estimate is made, although the scheme is kept in mind as of use in constituting a part of the ultimate programme of work for Sault Ste. Marie's future water supply.

Possibilities at Cold Water Creek Investigated

Aside from the St. Mary's River source of water supply, Mr. Wynne-Roberts investigated the possibility of using Cold Water Creek and, in fact, the recommended suggestion is based on this as a source. The head of Cold Water Creek is located about five miles north and west of the city. The two short streams which converge to form Cold Water Creek have their sources at a number of springs which are situated at the base of a deep bed of gravel and sand, having an area of 2½ square miles. The quantity of water flowing from the springs is much greater than can possibly be due to the fall of rain on the surface of gravel deposits, and an investigation shows that by far the larger proportion of this water is derived from the Root River, an adjoining stream. The Root River, for at least a mile and a half, and perhaps three miles, flows over gravel deposits, and in doing so loses much water which percolates into the bed and ultimately finds its outlet in the numerous springs on Cold Water Creek. This latter stream is therefore supplied by water from the drainage area of a part of Root River at least, and precipitation upon the 2½ square miles of spring area. The minimum water shed which can be considered as supplying Cold Water Creek is 26 square miles in area, which, together with 2½ miles of gravel deposits, makes a total of about 28½ square miles of collecting area. This figure can be safely used to calculate the possible yield of Cold Water Creek.

Lakes Act as Equalizers

The number and magnitude of the lakes of the water shed in question are important, inasmuch as they tend to act as equalizers of the volume discharged in serving as storage in wet weather and yielding it in dry.

Metereological observations have not been made for the catchment area of Root River and Cold Water Creek, but for purposes of calculation the precipitation at the city of Sault Ste. Marie, Mich., which, owing to ground conditions will be less than in the higher districts nearer the river, may be used. For the three consecutive years, 1905 to 1907, including the driest year, 1906, the average annual rain fall was 24.65 in. The evaporation on that particular type of ground is estimated as 8 inches, leaving during years of drought a balance of about 16.65 in. This would be equal to a daily discharge of about 22½ million U. S. gallons from the water shed of 28½ square miles. The flow in the Root River will fluctuate and probably be at its lowest about February. The springs will not fluctuate to any appreciable extent because of the great storage capacity of the gravel beds. The discharge of Root River, with a catchment area of about 26 square miles, may fall to about three or four million gallons daily.

Overflow Weir Recommended to Impound Water

Measurements that have been made of Cold Water Creek seem to indicate a discharge averaging about 9,500,000 gals. daily and that this discharge is remarkably constant. The construction of an overflow crib weir in Root River below the gravel beds referred to above is recommended as serving to impound water whereby under the increased head the percolation into the porous bed will be increased. In the course of time the porous gravel and sand will tend to become choked by silt, but as the river water carries but little sediment or matter the process will be a slow one and periodic ploughing or harrowing will enable freshets to carry away the finer particles.

The examinations that have been made in regard to the purity of Cold Water Creek supply show that the water can be considered beyond question and as there are only two farms or dwellings adjoining the stream at the present time, it is seen that contamination is not serious. If proper precautions are taken to isolate the intake area and preserve this section from pollution, assurance can be given that the quality of the water will be excellent.

Provision for Contingencies

In considering Cold Water Creek as a possible source, the author of the report takes into account the need of providing for contingencies, although the quantity yielded by the springs is sufficient for a population much greater than will be found in Sault Ste. Marie for a long time. There are two possible steps open for consideration in order to increase the yield if at any time it should be necessary. The first will be to sink a large well or a number of smaller ones, at or near Cold Water Creek or Root River. The second is to use Silver Creek, a stream located a short distance east of Cold Water Creek.

In what is called Cold Water Creek Scheme No. 1 the water from the two branches of the Cold Water Creek is collected by an overflow weir into a chamber at the foot and conveyed by gravitation to a pumping station near the Root River. The pumps would be operated electrically and would lift the water from a screen well and force it for a distance of about 2½ miles to a high level reservoir and thence to the city by two 24-inch mains. At the Root River station there would be three seven million gallons per day centrifugal pumps and at the high level sub-station there would also be three motor-driven pumps of the same capacity, as well as a reserve set driven by steam. This sub-station would be to boost the fire pressure and to pump water to the high level districts.

The principal disadvantage would be the long lengths of cast-iron delivery mains from the reservoir to the city and a separate staff of men at the sub-station.

Cold Water Creek Scheme No. 2

A gravitation arrangement is suggested in Cold Water Creek Scheme No. 2. For the gravity line a reinforced concrete conduit from the same intake as in the previous scheme, passes down the valley of Cold Water Creek along the Garden River road to the Root River bridge and down New road, making a small detour south of the Root River bridge to avoid a rock cutting. A reservoir and pumping station would be located in the city. The total length of conduit would be approximately six miles. The water would be pumped into the city mains which would have a connection to a balancing reservoir of, say, five million gallons capacity, which would be available for use during the night or to feed pumps for fire purposes. The pumps would be in duplicate, one set operated by electric motors and the other by steam or Diesel engines. In this scheme, pumping machinery is centralized in the city under better supervision and easier control.

In comparing the different arrangements, the consulting engineer considers the Cold Water Creek as excellent in quality, rendered pellucid by natural filtration and sufficient in quantity to fulfill Sault Ste. Marie's needs for a long time. The works would be located on municipal or public property and would be easily accessible to repairs and maintenance. On the other hand, the St. Mary's River, although affording an inexhaustible supply, must be rendered safe from pollution by filtration. Repairs and maintenance of submerged pipes and works would be difficult and expensive, and owing to the future expansion of shipping, the permanence of the intake works can hardly be assured.

Table of Costs

The following table shows the estimated capital and annual expenditure for the various schemes incorporated in the report:—

	Capital Expenditure. for 30,000 pop.	for 26,000 pop.
Moore Point Scheme, No. 1..	$754,160	$599,060
Moore Point Scheme, No. 2—	728,970	570,790
Old Beacon Rock Scheme ...	757,680	588,830
Coldwater Creek Scheme No. 1	802,758	582,274
Coldwater Creek Scheme No. 2	628,870	538,120
	Annual Cost.	
Moore Point Scheme, No. 1..	84,352	64,916
Moore Point Scheme, No. 2..	86,660	66,889
Old Beacon Rock Scheme ...	84,896	66,696
Coldwater Creek Scheme, No. 1	84,593	62,375
Coldwater Creek Scheme, No. 2	69,476	55,536

A Joint Engineering Council

The national engineering societies of the United States have created an Engineering Council to facilitate united action by the engineers of that country in matters of a technical nature. This council is in reality an outgrowth of the United Engineering Society formed some years ago for the purpose of carrying out the scheme of the Engineering Societies Building at 29 West 39th Street, New York, designed to be a home for all the engineering societies of the country. The by-laws of the United Engineering Society have now been changed to admit of the creation of an Engineering Council formed of five representatives of each of the constituent societies and four representatives chosen by the Board of Trustees of the United Engineering Society. Provision is also made for the addition of representatives from other engineering societies not at present included.

This Engineering Council appears to be very similar in constitution to the Canadian organization, the "Joint Committee of Technical Organizations," though the scope of its membership is for the present somewhat circumscribed. The aims are identical in that both have been called into being to discuss matters which are common to the different branches of the engineering profession.

A Two-Motor Street Flusher

THE advantages of the flushing system of cleaning streets are well recognized. Where adequate water pressure is not available special flushing trucks are employed to displace the customary use of fire hose attached to hydrants. Even when the requisite hydrant pressure is to be had, it is clearly evident that there is greater economy of water and a capacity for much more thorough cleansing in the use of a motor-driven flusher which carries the water to the point where it is needed and delivers it, at the most effective angle, through nozzles under the direct control of the operator.

The development of an efficient flusher has received a great deal of attention. The underlying principle of one of the latest machines is to have the motor truck and the flusher unit each complete in itself, so that the flusher could function perfectly as regards pressure and discharge of water even if removed from the truck chassis and placed on the ground or on a horse-drawn vehicle.

The flusher unit has a separate gasoline motor of its own which operates a centrifugal pressure pump. This enables the operator to shape the course, alter speed and in every way manipulate the motor truck proper irrespectively of the flusher apparatus; and conversely, it also enables the operator to control the pressure of the water delivered on the streets or elsewhere absolutely without regard to the speed of the propelling vehicle. The operator can increase the water presure, even while slowing down the vehicle, which heretofore has been impossible without changing the speed or the speed gears of the propelling vehicle. This type of construction also enables the builder to balance the power required for the two separate units in the most economical manner possible. For instance, the vehicle motor can be operated on high speed (or on direct drive) wherever the condition of the streets permits. This naturally means economy in the use of both gasoline and oil for the propelling vehicle. Furthermore, a motor may be selected to operate the pressure pump that is of ample power and not overpowered for the functions it must perform. The range of pressure obtained can be varied from a few pounds up to 60 or 70 pounds at the operator's will and is affected only by the number of nozzles that may be used or opened at one time. The operator can start his vehicle motor and the pump motor, open up the nozzles he requires to perform the work in hand, set his throttle for the pump motor at a point that will maintain even and constant pressure and proceed to his work. He can then, altogether independently, manipulate the propelling vehicle as conditions warrant, slow down for intersections, street car tracks or bad holes, change gears for grades, or coast on grades, and the pressure on the water that is being delivered to the streets will remain absolutely constant.

What is believed to be the largest diameter wooden stave water pipe line ever constructed in America is being manufactured at Seattle for a Pittsburg, Pa., steel company. The pipe will be over two miles in length and twelve feet inside diameter. It will take 100 railroad cars to transport these Douglas fir stave pipes from Puget Sound to Pittsburg, and, in addition, will require 50 cars to haul the steel bands and other equipment necessary for the erection of the pipe line. This will amount to over five train loads of material in the contract.

Power From the Montreal Aqueduct

Comment by Committee of Ratepaying Engineers on Report of Board of Engineers

FOLLOWING the report on the feasibility of power development in connection with the Montreal Aqueduct Scheme and the advisability of discontinuing the work which is partly completed; by a board of three engineers appointed by the city of Montreal, the Committee of Ratepaying Engineers have now published their comments on this report, in which they express their gratification that the report and recommendations of the three engineers correspond in their main features so accurately with their own findings. The Committee of Ratepaying Engineers have issued their comments in the form of a print-report, from which the following are extracts:—

The following contentions of our report are clearly supported:—

(a) The project as designed is condemned.

(b) Ice troubles are admitted to the degree that it is estimated the plant will be completely shut down for an average yearly period equivalent to 2.4 months.

(c) Radical changes in design, at greatly increased cost, are shown to be necessary to obtain the amount of power claimed by the city.

(d) Purchased power or steam-generated power is shown to be much cheaper than that which could be produced by the aqueduct.

(e) No power from the aqueduct would be available for lighting the city.

(f) The capital costs and annual charges are shown to be greatly in excess of the estimates made by the city.

Various Statements are Compared

The following is a brief comparison, by means of parallel columns, of statements made regarding the various features of the Montreal Aqueduct Power Development Scheme. The first column is based on published statements by the city up to the end of 1916. The second column is based on the "Report by Ratepaying Engineers," dated November, 1916. The third column is based on the "Report on Aqueduct Enlargement, Montreal Water Works" by the Board of Engineers, Messrs. Vautelet, St. Laurent and McRae, dated April 30th, 1917.

The City	The Ratepaying Engineers	The Board
1.—Power obtainable from the Enlarged Aqueduct in Electrical Horse-Power.		
Winter minimum, 9,000. Summer minimum, 18,000. Yearly average, minimum, 14,000	Maximum as designed, 7,000.	"Winter, 5,600. Summer, 8,900." (p. 22) With radical alterations and additions, 9,750.
2.—Probable Ice Troubles in Operation.		
Stated frequently that there would be no ice troubles.	Stated that "serious operating troubles due to ice are inevitable."	States that there will be ice troubles, "equivalent to a complete shut down for 2.4 months each year." (p. 11).
3.—Capital Cost of the Project.		
Variously stated the cost from $2,500,000 to $9,500,000.	Gave the cost as over $10,600,000. (All data for complete estimates were not then available.)	Gives the cost as over $10,600,000, but did not include in the cost certain important items amounting to about $1,400,000, which would make the total cost at least $12,000,000.
4.—Annual Unit Cost of Power from Aqueduct.		
Variously stated cost from $13.33 to $40.00 per horse-power per annum.	Said this cost would be $108 per electrical horse-power per annum, including sinking fund and depreciation.	Gives this cost as $56.90 per theoretical horse power. (This is equivalent to $76.00 per electrical horse power. In this cost the Board does not include sinking fund and depreciation. It is based on a capital cost of $10,600,000. Based on a capital cost of $12,000,000 and including sinking fund and depreciation this annual unit cost is over $100 per electrical horse-power.)
5.—Study of Project as a Whole previous to Board's Investigation.		
Frequently stated that project had been studied as a whole.	Always stated that "project had never been studied as a whole."	Would not answer this question when put by Mr. Commissioner Villeneuve.
6.—The Necessity for the Undertaking.		
Undertook the present project and declared it very advantageous.	Stated that "the capacity of the original aqueduct was sufficient for three times the present population served, if used for water supply only, and not for hydraulic power," and also that "the present project should never have been started."	Says:—"Had the old aqueduct been left as it was, simply as a supply to the steam pumps, a steam plant would have been a most attractive proposition." (p. 39).

7.—Proposed Completion of Work.		
Persists in continuing, extending and completing the work in spite of protests.	Stated that "all thought of completing the project, along the present lines, should be abandoned."	Stated that the present scheme "is the one to which exception has been taken, and we agree that it should not be proceeded with as outlined. It could not have developed the expected power." (p. 38). The Board does not recommend completion of the project, even after radical modifications.
8.—Solution of the Problem.		
Stated that aqueduct power is the cheapest and best, and recommends completion of project.	Demonstrated the economy of abandoning the project as designed, making the most advantageous use of the work done and purchasing the balance of power or generating it by steam power.	Does not make any definite recommendation for the solution of the problem, except that firm bids on electric power be asked for.
9.—Possibility of Lighting the City Streets by Power from the Aqueduct.		
Stated that power from the aqueduct would be available for lighting the streets, with a surplus of power for sale.	Showed that lighting the streets with power from the aqueduct is impracticable.	Shows that no aqueduct power would be available for lighting streets. (p. 33).

The above comparison shows a general concurrence by the Board of Engineers with conclusions of the Ratepaying Engineers.

It is important to note that:—

I. It was only after the protest by the Ratepaying Engineers in April, 1916, that the city began serious studies of the whole project.

II. After the report by the Ratepaying Engineers in November, 1916, the city proposed radical changes in design at additional cost, to meet some of the objections raised. The Board's investigation and report show that further changes in design must be made involving over a million dollars additional cost before the amount of water power claimed by the city could be approximated.

III. The project as proposed by the city is strongly condemned by the Board.

IV. The whole project has become so badly muddled that after a long investigation the Board is unable to recommend a definite course of action, but merely recommends asking tenders for electric power and making further studies.

Certain Matters Not Reported

The resolution of February 6th, 1917, appointing the Board, called for a comparison between the report of the Ratepaying Engineers made in November, 1916, at the request of the City Council, and the different reports of the City Engineer. This comparison has not been made.

This resolution stipulated that a complete study of the proposed development was to have been undertaken, and a report made "as to whether the development is feasible, practical and advantageous, and to advise the city on its advantages and disadvantages, with every recommendation which they (the Board of Engineers) will judge proper to make to the city." It cannot be said that this has been done.

Mr. Commissioner Ross's letter to the Board of Engineers dated February 16th, 1917, apparently advised the Board to disregard the reports referred to in the resolution of February 6th, 1917, but suggested that the Board advise the city as to the right and wisest course for the city now to follow from a business point of view. The Board apparently accepted this letter from one of the Commissioners as instructions overriding a resolution of the city, but failed to make definite recommendations as to the right and wisest course for the city to follow.

Cost Charges of Board's Report Criticized

In the report and the detail figures sent to the city by the Board certain items are omitted which are clearly chargeable to the capital cost of the aqueduct enlargement. The excess costs of the present steam pumping over that formerly done by the old aqueduct from 1907 until the completion of construction work, the repairs to the lateral conduit after the break in 1913 which was due to the construction work on the aqueduct, the emergency water supply from the Lachine Canal in this connection, the cost of ten bridges, and certain interest charges during construction, in all amounting to about $1,400,000 are omitted. This makes the total cost $12,000,000. This figure might easily reach $14,000,000 if the cost of all work on the boulevards be included and if any substantial portion of the claims of the Cook Construction Company be allowed.

In comparing the annual unit costs of power purchased with the unit cost of power developed, the Board does not place them on the same basis for comparison. The only proper basis for comparison is for power available as "electrical horse-power" delivered on the switchboard at the Atwater Avenue plant, whether produced by the water in the aqueduct, or purchased in the ordinary commercial way as electrical power, or produced from a steam-electric plant.

Power Costs

As shown on page 14 of the Board's report, only three-quarters of the theoretical water power is available as electric power at the switchboard after deducting the various losses through the water wheels and generators, and therefore in making a comparison with purchased power on a unit basis only three-quarters of the theoretical water horse-power should be considered. In the table of unit costs on page 38 of the Board's report, the cost under Scheme II, is given as $56.90 per theoretical water horse-power per year. In the same table purchased electrical horse-power at $25.00 gives a total annual unit cost of $62.47 per electrical horse-power, or, on a proper basis of comparison, a difference of nearly $14.00 per horse-power per year in favor of purchased power.

This practically agrees with the relation of the total figures given on page 35 of the report where the total costs of developed aqueduct power under Scheme II are given as $740,000 per year and the total costs of purchased power are less and are given as $656,000 per year.

No Provision for Depreciation

In the Board's calculations of annual costs of power there is no provision made for sinking fund nor for depreciation. Based on the capital expenditure of $12,000,000 and with proper allowance for sinking fund and depreciation the total annual operating costs and fixed charges would amount to at least $1,000,000, equivalent to over $100 per electrical horsepower.

In view of the foregoing there appears to be no justification for the statement on page 41:—"Under ordinary circumstances and with the figures now before us, we would have no hesitation in recommending the adoption of Scheme II with provision for Boulevards, **as its cost of operation per h.p. per year is the lowest.**" If all cost items are included, either purchased power or steam generated power is much cheaper than water power developed under Scheme II.

A supplementary resolution of the city dated February 26th, 1917, voted an additional credit to the Board on the understanding that the Board was to answer questions submitted in writing by Commissmissioners or Aldermen. Mr. Commissioner Villeneuve, whose various published commentaries on the aqueduct question during the past year have shown his great interest in this important matter, submitted seven questions on April 30th, 1917, with a definite request for specific replies. In a letter dated May 10th, 1917, submitting their report to the city, the Board referred to these questions but did not reply to them except to say that the information would be found in the report.

After a study of the report we conclude that three or perhaps four of Mr. Villeneuve's questions are fairly covered by the report, but we cannot say this of the others.

In an interview at the City Hall, June 6th, 1917, the Board replied verbally to a number of other questions put to them; and we conclude from the answers as submitted to us that no well defined course of action was then recommended.

Recommendations of Ratepaying Engineers

As a solution of the problem at the present time, we now urge once more that the proper course for the city to follow is to immediately stop all work on the enlargement of the aqueduct as contemplated, make the most advantageous use of the work done and purchase the balance of the electrical power required or generate it by means of a steam plant. The "most advantageous use of the work done" at the aqueduct might possibly entail the construction of a comparatively small hydro-electric plant, to be operated during the summer, in conjunction with power purchased or produced by steam, so as to keep the load factor high and constant and to take the summer pumping peak load. The size of the plant suggested should not be greater than is necessary to take care of the difference between average and peak pumping requirements or about one-third of the total power required. On this basis the size of the suggested plant should not exceed 3,500 electrical horse-power, and the economical size might prove to be between 3,000 and 2,000 electrical horse-power, or even less, depending on the terms of the power contract entered into.

Deplorable Financial Position

The financial position of Montreal is deplorable. The necessary funds are not authorized nor available to complete the aqueduct power development project. The incompetence, or whatever it may be, that has permitted the wasting of millions in this one scheme alone is sufficient to shake the confidence of any banker or investor with regard to Montreal securities. The ratepayers of the city have the right to expect that value be obtained for all monies expended, and investors in our municipal securities have the right to know that their investment is sound and that it has been protected by works carried out along true economic lines, which is far from being the case in the present instance.

The Committee of the Ratepaying Engineers, having submitted these comments, feel that they have fulfilled their duty as citizens, and completed the work they undertook in the interest of the taxpayers and at the request of the City Council.

We are pleased that our opinions have been so strongly supported by your Board of Engineers, and and that our criticisms of the aqueduct power scheme have been fully justified."

The Committee of the Ratepaying Engineers consists of W. F. Tye, Chairman; John Kennedy, Ernest Marceau, J. A. Jamieson, R. A. Ross, Arthur Surveyer, Walter J. Francis, Secretary.

Concrete Ships—Why Not?

(Concluded from page 614)

four experts, all of whom expressed much satisfaction at the result.

"Two other lighters are now on the stocks, and a large slip for a 4,000-ton craft is nearly completed. More than 200 men are now working in the new yards, and five lighters have been contracted for in addition to the one completed and the two on the slips."

Present Conditions Impose Consideration of Concrete

In view of such examples proving the usefulness of concrete vessels of this character, it would seem wise to consider concrete in the construction of ships which are to increase the merchant marine to the proportion demanded by the present requirements. If sea-going barges were to be constructed, or smaller craft suitable for lake traffic, this would release for other purposes many ships now in use in this capacity. The presence of the necessary materials for a concrete vessel at so many convenient locations would make it possible to provide a large tonnage, and progress in construction would be faster than with ships of steel or even wood.

Hon. Frederick Nicholls, in the Senate on July 11, secured adoption by the Senate of a resolution declaring it expedient that the Senate "appoint a committee to inquire into and report upon the best method of conserving and increasing our domestic and overseas trade to the end that our present prosperity may not unduly suffer when the stimulus resulting from orders for munitions and other war supplies is removed." Senator Nicholls' speech in connection with the resolution was reported in the Contract Record of June 27, page 567.

Important Discussions at Convention of American Society for Testing Materials

Rolling Increases Strength of Slabs—Use of Roller to Finish Concrete by Removing Excess Water Adds 20 Per Cent. to Strength and Permits Use of Wet Mixture

THE importance of proper water content for concrete is generally recognized. The amount of water producing a maximum strength makes such a stiff mixture that it is impracticable in most concrete road work. It is necessary, therefore, to use a certain excess of water above that which will give the greatest strength.

In concrete road work, owing to the method of handling, it is of considerable convenience to use a fairly wet mixture. It has been found, however, that much of the excess water can be removed by proper manipulation of the concrete after it is placed. As a consequence some methods of finishing concrete roads have been productive of exceptionally good results. A study of the methods employed shows that while they differ as to detail, in each case the concrete surface has been so treated as to remove a considerable amount of the excess water, thereby making the surface more compact and dense.

Of the different methods which have been observed, that devised by Captain Gaillard, City Engineer of Macon, Georgia, seems to be the most efficient and least expensive. This method consists in rolling the surface of the concrete with a light roller about 8 inches in diameter, and 5 to 6 feet in length, attached to the end of a long pole. The roller is made of light sheet metal; the total weight of a 6-foot roller being in the neighborhood of 70 lbs. The operator stands at one side of the roadway and rolls the newly laid concrete transversely to the direction of the road.

This method was originally developed to remove any unevenness in the surface, but it really accomplishes a very much more important result, as it squeezes out of the concrete much of the excess water.

In order to determine the effect on the strength of a concrete produced by the finishing method described above, a number of slabs were made for testing purposes, mixed and molded in much the same manner as in concrete road work, the exact proportions of water and other materials being recorded. The principal variation was in the consistency of the concrete and the method of finishing the surface. The results of these tests, which were carried out at the Lewis Institute, were reported by A. N. Johnson, of the Portland Cement Association, at the meeting of the American Society for Testing Materials, as follows:

Twelve Slabs Tested

Twelve slabs, 2½ ft. wide, 5½ ft. long and 5 inches in thickness, were made and tested. Pebbles were used as coarse aggregate for six of these and crushed limestone was used for the others.

The concrete was mixed in the proportion of 1 part cement to 4 parts total mixed aggregate by volume—a proportion approximately equivalent to the ordinary 1:2:3 mix. Three sets of slabs, two slabs in each set, were made from both crushed limestone and pebbles as a coarse aggregate.

The following consistencies of concrete were used in the test:

1. Dry consistency, finished with a wood float in the ordinary way;
2. Wet consistency, finished with a wood float in the ordinary way;
3. Wet consistency, finished by means of a roller, as previously described.

The concrete for the slabs of dry consistency was mixed as stiff as could be easily handled—stiffer than is ordinarily found in concrete road work. The mixtures for the remaining slabs contained a somewhat larger amount of water, making a consistency that would ordinarily be classed as "good" in practical work.

Roller Finish to Wet Mixes

All slabs of the stiffer consistency, as well as one of the slabs of each other set, were finished by being first struck off with a straight edge and then floated by hand with a wooden float. The remaining slabs of each of the wet consistency sets were finished by the use of a roller. The concrete was left a little more than flush with the sides of the mold, and instead of being struck at once with a straight edge, it was first rolled: the straight edge was then used to strike off what surplus concrete remained. To bring the full weight of the roller—which was just long enough to rest upon the side forms—on the concrete the slab was rolled transversely at intervals of about 15 minutes for 1½ hours, five rollings being made. The roller was moved back and forth over the width of the slab, moving sidewise a few inches with each stroke. As each rolling was made, considerable water was squeezed out of the concrete and forced over the sides of the mold. The rolling continued until the amount of free water became very small. No particular difference in the amount of rolling to effect this was noticeable for the limestone concrete and the gravel concrete. It was noticed, however, that the roller sank into the gravel concrete considerably more than into the rock concrete during the first one or two rollings.

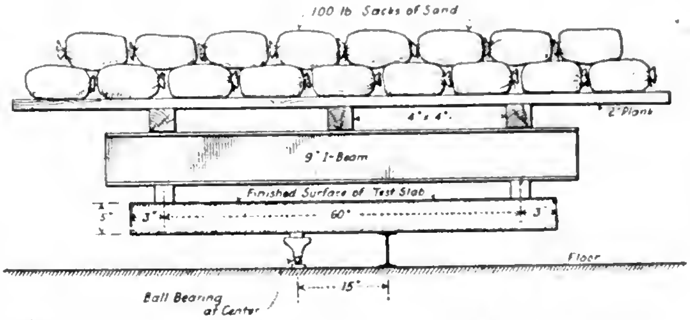


Fig. 1—Showing method of applying load to slabs

The roller used was 2½ feet long, 6 ins. in diameter and weighed about 50 lbs. In practical road work,

Table I.

Specimen No.	Age at Test, days.	Total Applied Load, lb.	Thickness,[1] in.	Kind of Coarse Aggregate.	Water Used, Percentage of Volume of Aggregate.	Modulus of Rupture of Concrete, lb. per sq. in.			Compressive Strength of Concrete (6 by 12-in. cylinders), lb. per sq. in.
						Medium Consistency, Wood-Float Finish.	Wet Consistency.		
							Wood-Float-Finish.	Roller Finish.	
1	15	3300	5.20	Pebbles	15.9	301	...	...	....
1a	15	3200	5.14	Pebbles	15.9	302	...	...	2370
2	15	3200	5.18	Pebbles	18.6	...	294	...	1760
2a	15	3500	5.27	Pebbles	18.6	...	311	...	1730
3	15	3850	5.32	Pebbles	18.6	...	...	331	1680
3a	15	3400	5.07	Pebbles	18.6	...	...	325	1680
4	15	4000	5.25	Crushed Limestone	15.9	353	...	...	2130
4a	16	4500	5.18	Crushed Limestone	15.9	405	...	...	2290
6	15	3000	5.11	Crushed Limestone	18.6	...	288	...	1600
6a	16	3750	5.20	Crushed Limestone	18.6	...	340	...	1680
5	15	3650	4.87	Crushed Limestone	18.6	...	...	378	1330
5a	16	4950	5.17	Crushed Limestone	18.6	...	...	443	1800
Average.	......	....	......	....	....	340	308	369	

[1] Thickness of the slabs at the broken sections.

NOTE.—Concrete was machine-mixed in the proportion of 1 part cement to 4 parts aggregate, by volume. Size of slabs, 30 by 66 by 5 in. Loaded with dead weights at points 15 in. apart on 5-ft. span. Duplicate slabs were made on different days.

an 8 inch roller about 6 feet long, weighing about 70 lbs., is recommended.

Loading Arrangements

The forms were removed the following day, when the slab was covered with a layer of damp sand which was kept moist until the slabs were one week old. The sand was then removed and the slabs lifted from the floor and permitted to dry out during the remaining eight days before the load was applied.

The arrangement for applying the load to the slabs is shown in Fig. 1. The slabs were placed on two supports spaced 15 ins. on centers, resting on the floor. A ball bearing on the lower side of one support compensated for what warp there might be in the lower surface of the slab. The load, which consisted of 100-lb. sacks of sand, was supported by two 9-inch I-beams, and was transmitted to the slab through two bearings spaced 5 feet apart. The upper surface of the slab was thus put in tension. Each test was made in the same manner, and as far as practicable the loads were applied at the same rate until rupture.

The appearance of the broken slabs disclosed a marked difference between those finished with the roller and those finished with the wooden float. The roller-finished slabs showed a distinctly denser appearance, extending for at least one-half the depth of the slab. It is to be noticed (see Table 1) that the slabs tested when they were 16 days old show a consistent increase in strength over those 15 days old.

With the small number of test specimens, there are not sufficient data to determine definitely any special difference between the strength developed by the slabs made of pebbles and those with the crushed limestone. It is to be noted, however, that the pebbles used were somewhat irregular in shape, some pieces being broken.

The broken sections of all slabs, particularly those that were rolled, showed that many pieces of the coarse aggregate had been broken apart, the number of broken pieces being considerably greater in the rolled slabs than in those not rolled. There was no difference especially noticeable in this particular, between the slabs made of the limestone and those made of the pebbles.

Rolling Increases Strength

The results of the tests are shown in Table 1. The noticeable fact is that those slabs finished with the roller developed a very considerable increase in strength over the slabs merely hand-finished. The four slabs of wet consistency that were finished by hand, have an average modulus of rupture of 308 lbs. per square inch, while the four slabs finished with the roller have an average modulus of rupture of 369 lbs. per square inch, or an increase of almost 20 per cent. As would be expected, the slabs that were made of a stiffer mixture, indicated in Table 1 as medium consistency, giving an average modulus of 340 lbs. per square inch, are stronger than those of the wet consistency, finished in the same manner; but the wet-consistency slabs finished with the roller are stronger than those of the medium consistency, showing an increase of nearly 10 per cent.

The results seem to indicate clearly the value to be gained by the use of the roller to finish a concrete road; that it is possible by proper manipulation of concrete to secure increased strength and density of a character most desirable for a concrete road surface; and that such surplus water as may be required to facilitate placing concrete in road work can be effectively removed by this simple expedient.

The Effects of Grading of Sands and Consistency of Mix Upon the Strength of Plain and Reinforced Concrete

AN interesting paper was read by Mr. L. N. Edwards, supervising engineer of bridges for the city of Toronto, at the recent convention of the American Society for Testing Materials, held in Atlantic City, June 26 to 29. The subject of Mr. Edwards' paper was "The Effects of Grading of Sands and Consistency of Mix upon the Strength of Plain and Reinforced Concrete." The paper presented the results of three series of tests made by the Department of Works of the city of Toronto, under the direct supervision of Mr. Edwards. These tests were undertaken with the object of securing information relating to (1) the influence of the grading of sand; (2) the effect of the consistency of mix upon the strength and physical characteristics of the concrete properties, and (3) the effect of varying the time of mix.

The author described the methods used and the results obtained, in considerable detail, and drew the following conclusions:

Common Practices Unreliable

1. The commonly practiced "visual examination" test of sand aggregate for concrete is generally unreliable, since it gives at best only a superficial knowledge of the cleanliness of a given sand. Its adaptation to the determination of grading could be of value to the observer only after long experience in the granulometric analysis of sands.

2. The generally accepted practice of proportioning a concrete mix by volume, as, for example, 1 part cement, 2 parts sand and 4 parts broken stone, is impracticable and unscientific, since it does not take into account the adaptability of the grading of a given sand to the production of a dense, strong, and reliable concrete. Proportioning by volume, as commonly used,

gives no guarantee of the production of a concrete having a desired strength, hardness, or other physical properties.

3. The strength, toughness, and durability of the concrete to be secured from the use of a given sand can be determined only by an actual test of that sand in a properly prepared concrete.

4. In field operations incident to spading, slicing, or otherwise compacting the concrete, the movement of the water content of the mass is intensified, whenever the sand aggregate contains insufficient fine material to hold the cement in suspension by the formation of an adequate amount of sandy paste. The free movement of the water tends to produce an improper distribution of the cement.

Amount of Water

5. The use of a quantity of water sufficient to produce a concrete, the mortar component of which is of a saturated, sticky, semi-plastic consistency, is for most practical purposes required, in order to facilitate economical and efficient placing. This quantity of water is ample for the development of the proper functions of the cement. An increase in the quantity of water used results in a proportionate decrease in the strength of the concrete. This decrease is in no sense a function of the proportions of the mix.

6. The excess water in an over-saturated concrete necessarily occupies space and thereby bulks-up the mass. By reason of its high surface tension, it forms water globules which, although somewhat affected by the weight of the concrete, are nevertheless distributed throughout the mortar component and are accumulated underneath the particles of the sand and stone aggregates and the reinforcing steel. By evaporation, this excess water ultimately disappears, leaving a considerable volume of water voids and cavities which constitute an extremely important factor in the strength and reliability of the concrete.

Bond Between Concrete and Reinforcing

7. The critical failure of reinforced concrete depends upon the intensity of the bond existing between the concrete and the steel reinforcement. Concrete containing an excess of water not only develops less surface contact with the steel on account of the resulting increase in the volume of water voids and cavities; but, in addition, the excessive laitance produced by the water tends to accumulate around the reinforcement, thus contributing materially to a decrease in strength. This condition becomes further aggravated by reason of the tendency of the laitance to become less resistant with age.

8. For the various grades of concrete, the minimum ultimate strengths assumed in the modern practice of plain and reinforced-concrete design are not assured by the commonly specified requirements for sand and stone aggregates, and by the present lack of uniformity and of efficiency in field methods and operations.

9. The results obtained show no definite relation between the compressive strengths of 1:3 mortar cubes, and the compressive strengths of the concrete produced from the same sands.

In the course of the paper the author took occasion to submit the following specifications for a cement to be used for general concrete purposes. These specifications assume that provision is made for the proper proportioning of the cement content of the mix in cases where cements failing to meet the strength requirements are used. They also assume that proper provision is made for the limiting of the water content of the mix to that required to produce a saturated, sticky, semi-plastic mortar:

Sand shall be of hard, preferably silicious, material, clean, rough, free from dust, soft particles, vegetable loam or other deleterious matter. It shall consist of particles graded from coarse to fine, of sizes that will pass, when dry, a sieve having 4 meshes per linear inch. The grading of particles shall otherwise conform to the following:

Not more than 80 per cent. shall pass a sieve having 10 meshes per linear inch, not more than 55 per cent. shall pass a sieve having 20 meshes per linear inch, not more than 15 per cent. shall pass a sieve having 50 meshes per linear inch, and not more than 5 per cent. shall pass a sieve having 100 meshes per linear inch. Upon the 10, 20 and 50-mesh sieves an allowable variation of 5 per cent. will be permitted.

Sand, when combined with a normal portland cement and 1-inch broken granite, limestone or trap of good quality in the proportions 10 lb. of cement, 21 lb. of dry sand, and 35 lb. of dry broken stone, thoroughly mixed with 4¼ lb. of water for not less than 1 minute and molded into cylinders 6 in. in diameter by 12 in. long, shall develop a compressive strength of 1,300 lb. per sq. in. when tested at the age of 7 days and a strength of 2,200 lb. per sq. in. at the age of 30 days. Strength shall be determined from an average of five cylinders tested at each age. The cylinder shall be removed from the form 24 hours after molding and shall be stored in a moist closet or in damp sand until tested.

Sand failing to develop the above strengths may, at the option of the engineer, be accepted for use, provided that the proportion of cement be increased by an amount sufficient to fulfil the strength test requirements.

Concrete Road Aggregates—Two Essential Properties of a Good Road (1) Uniformity of Wear (2) Minimum of Wear

ANOTHER paper by Mr. J. P. Nash summarized the results of tests on concrete road aggregates. The object of the tests was to determine the resistance to abrasion and the tensile strength of concrete made with various aggregates. Two of the most important essentials for a satisfactory road are: (1) uniformity of wear, and (2) minimum of wear. Whenever these two are combined with high tensile strength, the most satisfactory concrete road is found. The author draws the following conclusions from his tests:

1. The uniformity of wear is obtained when the mortar and the coarse aggregate wear equally, such as when crushed limestone or limestone gravel is used.

2. The coarse aggregate should be limited in size to about 1½ in.

3. When hard, tough stone is used, the size should be limited to about 1 inch and the cement content increased.

4. It is questionable if a richer mix than a 1:2:4 is an economical one to use with crushed limestone of the ordinary hardness. Crushed slag when hard and uniform should be satisfactory as a concrete road aggregate.

5. In a 1:2:4 concrete, a gravel composed of very hard stones such as flint, or quartz, does not wear uniformly.

6. The action of the cubical shot on the test specimens is a trifle more severe than the traffic on the road.

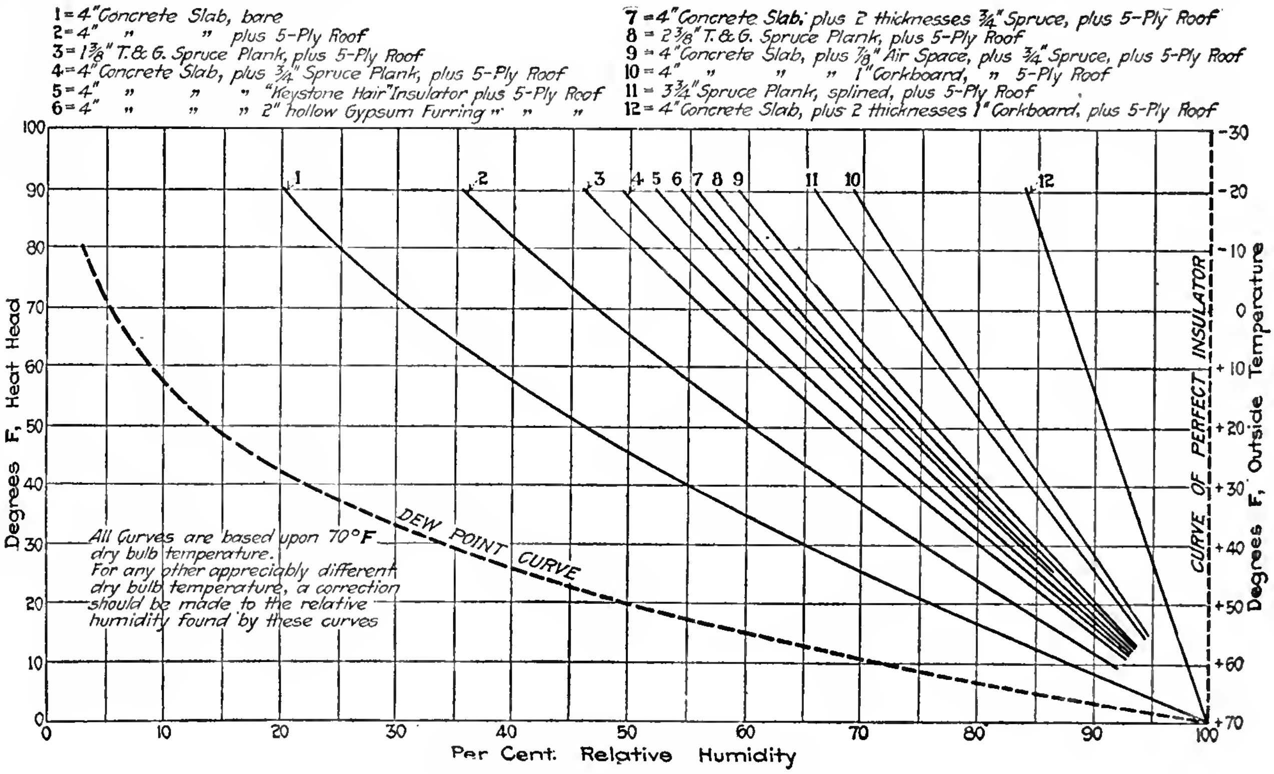
7. It cannot be said that either the crushed stone or gravel tested is superior as an aggregate to produce concrete having a higher tensile strength.

Relative Degree of Condensation on the Under Side Using Various Types of Roof

A SERIES of experiments to determine the relative effectiveness of various type of roofs in preventing the formation of condensation upon their under surface has been conducted by F. P. Sheldon & Son, engineers and architects, of Providence, R.I. The results were reported in some detail at the recent meeting of the National Association of Cotton Manufacturers by A. N. Sheldon, of the firm. The tests have especial interest because of their relation to the decay of wood roofs due to moisture conditions following condensation. The results are given as follows by Engineering News-Record:

ties being used as abscissas, and heat-head, or temperature difference, as ordinates. The curves obtained for various sample are shown herewith. Since they are based on 70 degs. F. dry-bulb temperature, the corresponding outside temperatures, as well as heat-heads, are also shown as ordinates. Each full-line curve represents some particular roof, and from it may be read directly the relative humidities at which, for any given temperature, these tests show that condensation can be expected to take place.

All curves are prolonged through a common origin, which is a theoretical point based on 0 degs. heat-head;



Curves show relative humidity that may be carried without condensation by different roofs.

Tests Made on Small Box

The tests were made on a prototype of an actual building, consisting of a box about 4½ feet square and 20 inches deep, so constructed as to receive as one face a roof specimen 3 x 4 feet in plan and so arranged as to permit interior variation and observation of moisture and temperature conditions.

Each sample roof was tested under three different conditions of heat-head to obtain results corresponding to outside temperatures of about 20 degs. F., 0 degs. F and—20 degs. F. for a given inside temperature of 70 degs. F. in each case. Formation of condensation on the under side of the roof was noted, occurring, of course, when the dewpoint of the air within increased and became equal to or higher than the temperature of the surface in question.

These tests embrace concrete and plank roofs with various types of insulation, and a curve was plotted on the three temperature points noted, relative humidi-

that is, if the temperature of the air on both sides of a roof of any material is the same, condensation will not occur until 100 per cent. relative humidity is reached. Starting from this point, two interesting theoretical curves may be drawn, as indicated by dotted lines. They constitute the limiting curves between which all materials whatsoever, from the most perfect conductor of heat to the most perfect insulator, must fall. The first, which is a vertical at the extreme right, is the line of the perfect insulator. It is purely theoretical and illustrates that, if it were possible to obtain such an insulator, 100 per cent. relative humidity could be carried at any difference in temperature between the outer and inner surfaces, because there would be no flow of heat and consequently no temperature gradient within the material; that is, the surface temperatures would be exactly the same as the air with which they are in contact.

The second curve at the extreme left is designated the "dewpoint curve," and represents the depression of the dewpoint (based on a dry-bulb temperature of 70 degs. F.) for various relative humidities from 3 to 100 per cent. This curve is also purely theoretical and illustrates that the poorest insulator will carry somewhat greater relative humidities than those indicated.

Wood Roofs Let Warm Moist Air Through Cracks

It should be noted that all these curves have reference to the particular relative humidity at which condensation will take place on the under side of roofs. With regard to wood roofs, there is another important consideration that must be taken into account; namely, the cracks between the plank afford a more or less direct channel by which the warm moist air in the room below may reach the under side of the roofing paper. Since the standard five- or six-ply tar and gravel roof is a poor insulator of heat, the temperature of its under surface is consequently but slightly warmer than that of its top surface. This results in a chilling of the air that comes in contact with it and the formation of condensation if the cooling is carried on beyond the dewpoint.

In buildings where artificial humidification is resorted to, or where the humidity is naturally high, Mr. Sheldon pointed out that this fact means nothing more nor less than that the first ply of roofing on the average roof of this type in this climate is wet during the greater part of the heating season. In a new building, moisture may not be evident until some time after erection, due to the hygroscopic property of the roof plank, the wood itself absorbing the condensation, if the deposition of the latter, on account of poor air circulation through the cracks, is not too rapid. But on a roof having wide cracks, condensation is certain to come sooner or later if the warm humid air of the room below comes in contact with the roofing paper. For this reason the top surface of the roof plank may be seeped with moisture, regardless of whether or not any condensation is present on the under surface.

Again, if cracks between the plank are so wide as to allow moderately free circulation of air, condensation often accumulates so rapidly as to run down the edges of the plank to the room below, manifesting itself in a line of drops at the cracks between the plank.

Mr. Sheldon says that this condensation is doubtless the direct cause for so much trouble being experienced at the present time with decaying wood roofs. If the temperature of the under side of the roof plank coincides with or is lower than the dewpoint for the particular humidity and temperature existing, there will be condensation upon this under surface and throughout the thickness of the plank; that is, in the cracks between the plank up to the under side of the roofing paper.

On the other hand, if the temperature of the under side of the roof plank is above the dewpoint, no condensation will be deposited here; but it may occur from the under side of the roofing paper down to a point somewhere within the interior of the plank, depending upon the heat gradient and the relative humidity. The presence of this moisture, due to the second cause—that is, within the roof plank—is a most active agency in providing the proper conditions for the development and rapid spread of disease throughout the roof. The prevention of condensation on the under side of the roof plank, while eliminating a nuisance in manufacturing, may not appreciably lessen the possibilities for decay.

It has been suggested that enough protection could be added in the form of more wood or other insulating material to the top of the roof to raise the temperature of the upper side of the plank to such a point as to prevent all condensation. And then, if data were made available by the forest pathologists as to the limiting conditions of relative humidity that various kinds of wood and different grades of the same wood can resist indefinitely without developing fungi, this information could be used in selecting the roof plank.

Condensation Thought Not Preventable

Invaluable as the above data on wood would be for use in the design of building interiors, such as beams, columns, floors, etc., Mr. Sheldon thinks that his experiments, confirmed by theory, indicate that the prevention of condensation on the top side of roof plank is impracticable for several reasons. First, the insulation would necessarily be so complete as to make the expense unwarranted. Also, if plank were used for this extra insulation, they should be antiseptically treated against rot, whereas it will be seen below that a fully satisfactory result will be attained at much less expense by the treatment of the roof plank only. Again, even if condensation within the area in question was prevented by this means, there would still be no certainty that plank selected as suitable for the room conditions would not rot, for the reason that the top side of these roof plank would be several degrees lower than the room temperature. This would result, of course, in a higher relative humidity than that existing in the room below, and consequently plank that might be suitable to resist decay under room conditions would not be so resistant under the actual conditions.

According to Mr. Sheldon, the successful solution of the problem of the design of wood roofs resolves itself into two requirements: The roof should be made thick enough, according to the accompanying curves, to prevent the occurrence of condensation upon its under surface. Secondly, it should be protected against decay, by proper preservative treatment.

New Steam Hoists Are World's Largest

THE hoist recently built for the Homestake Mining Company and now in regular service is the largest compound steam hoist in operation. It has duplex inclined cylinders, 28 and 52 x 42 in., driving two shafts linked with side rods. The cylinders meet at the apex of the triangular frame. The Homestake hoist will be surpassed in size, however, by an new machine now under construction by the Nordberg Manufacturing Company for another mining concern. This latter hoist will not only be the largest compound condensing hoist built, but in regard to capacity and depth will be the largest hoist in the world—in this surpassing the four-cylinder non-condensing hoist of the Tamarack Mining Company made 16 years ago. This new unit will have two high-pressure and two low-pressure cylinders, 32 and 60 inches in diameter, with a 66-inch stroke. The cylinders are placed at the base of the triangular frame with their rods running to a common crankpin. The drum will be of the cone-cylinder type, 16 ft. at the small diameter and 30 ft. at the large. This hoist is designed to handle 10 tons of ore from an ultimate depth of 10,000 feet, the shaft being inclined at an angle of between 35 and 54 degrees.

Building permits issued in the city of St. John, N.B., during the month of June, are valued at $62,750, as compared with $56,250 for the corresponding month last year.

Adaptability of Concrete and Reinforced Concrete—Uses, Precautions and Design

At the recent annual convention of the American Society for Testing Materials, Committee C.2, on reinforced concrete, (F. E. Turneaure, chairman), submitted its final report, "which is the result of the joint efforts of its own members and of the representatives of other societies appointed for the same purpose." This joint committee, formed as early as 1903, comprises special committees appointed by the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, Portland Cement Association, and the American Concrete Institute. A progress report was presented in 1912, since when the committee has continued its studies and followed the working out of its recommendations in actual construction, has weighed arguments and criticisms which have come to its attention and has considered new experimental data. The recommendations of the previous report have been revised to some extent and considerable new material has been added upon subjects not previously touched. There are some subjects upon which experimentation is still in progress, and the art of concrete and reinforced concrete will be advancing for many years.

While this report deals with every kind of stress to which concrete is subjected and includes all ordinary conditions of proportioning and handling, it does not go into all types of construction nor all the applications to which concrete and reinforced concrete may be put. The report is not a specification but may be used as a basis of specifications. In their use concrete and reinforced concrete involve the exercise of good judgment to a greater degree than do any other building materials. Rules cannot produce or supersede judgment; on the contrary, judgment should control the interpretation and application of rules.

The final report, which we propose to publish in a short series of articles, covers the reinforced concrete field very extensively. Those portions of the report dealing with the adaptability of concrete and reinforced concrete and the composite materials are reproduced in the present instalment:

Adaptability of Concrete and Reinforced Concrete

The adaptability of concrete and reinforced concrete for engineering structures or parts thereof, is so well established that they are recognized materials of construction. When properly used, they have proved satisfactory for those purposes for which their qualities make them particularly suitable.

1. Uses

Plain concrete is well adapted for structures in which the principal stresses are compressive, such as:—foundations, dams, retaining and other walls, tunnels, piers, abutments, and, in many cases, arches.

By the use of metal reinforcement to resist the principal tensile stresses, concrete becomes available for general use in various structures and structural forms. This combination of concrete and metal is particularly advantageous in structural members subject to both compression and tension, and in columns where, although the main stresses are compressive, there is also cross-bending.

Metal reinforcement may also be used to advantage to distribute and minimize cracks due to shrinkage and temperature changes.

2. Precautions

Failures of reinforced concrete structures have been due usually to some one or more of the following causes:

Defective design, poor material, faulty execution, or premature removal of forms.

To prevent failures or otherwise unsatisfactory results, the following precautions should be taken:

The computations and assumptions on which the design is based should be in accordance with the established principles of mechanics. The unit stresses and details of the design should conform to accepted good practice. Materials used for the concrete as well as for the reinforcement should be carefully inspected and tested, special attention being given to the testing of the sand, as poor sand has proved a frequent cause of failure. The measuring and combining of the materials which go to make up the concrete, and the placing of the concrete in the forms, should be under the supervision of experienced men. The metal for reinforcement should be of a quality conforming to standard specifications. Care should be taken to obtain good bond between different fills of concrete, to prevent concrete from freezing before the cement has set, to have the materials thoroughly mixed, to avoid too wet or too dry a consistency, and to have the forms cleaned before concrete is placed.

The computations should include all details: even minor details may be of the utmost importance. The design should show clearly the size and position of the reinforcement, and should provide for proper connection between the component parts so that they cannot be displaced. As the connections between reinforced concrete members are frequently a source of weakness, the design should include a detailed study of such connections.

The concrete should be rigidly supported until it has developed sufficient strength to carry imposed loads. The most careful and experienced inspection is necessary to determine when the concrete has set sufficiently for it to be safe to remove forms. Frozen concrete frequently has been mistaken for properly set concrete.

3. Design and Supervision

The execution of the work should not be separated from the design, as intelligent supervision and successful execution can be expected only when both functions are combined. It is desirable, therefore, that the engineer who prepares the design and specifications should have supervision of the execution of the work.

The Committee recommends the following practice for the purpose of fixing the responsibility and providing for adequate supervision during construction:

(a) Before work is commenced, complete plans and specifications should be prepared, giving the dead and live loads, wind and impact, if any, and working stresses, showing the general arrangement and all details. The plans should show the size, length, location of points of bending, and exact position of all reinforcement, including stirrups, ties, hooping and splicing.

(b) The specifications should state the qualities of the materials and the proportions in which they are to be used.

(c) The strength which the concrete is expected to attain after a definite period should be stated in the specifications.

(d) Inspection during construction should be made by competent inspectors selected by and under the supervision of the engineer, and should cover the following:

1. Materials.
2. Construction and erection of the forms and supports.
3. Sizes, shapes, arrangement, position and fastening of the reinforcement.
4. Proportioning, mixing, consistency, and placing of the concrete.
5. Strength of the concrete by tests of standard test pieces made on the work.
6. Whether the concrete is sufficiently hardened before the forms and supports are removed.
7. Protection from injury of all parts of the structure.
8. Comparison of dimensions of all parts of the finished structure with the plans.

(e) Load tests on portions of the finished structure should be made where there is reasonable suspicion that the work has not been properly performed, or that, through influences of some kind, the strength has been impaired, or where there is any doubt as to the sufficiency of the design. The loading should be carried to such a point that the calculated stresses under such loading shall be one and three-quarter times the allowed working stresses, and such loads should cause no injurious permanent deteriorations. Load tests should not be made before the concrete has been in place sixty days.

4. Destructive Agencies

(a) Corrosion of Metal Reinforcement.—Tests and experience indicate that steel sufficiently embedded in good concrete is well protected against corrosion, no matter whether located above or below water level. It is recommended that such protection be not less than 1 inch in thickness. If the concrete is porous so as to be readily permeable by water, as when the concrete is laid with a very dry consistency, the metal may corrode on account of the presence of moisture and air.

(b) Electrolysis.—The experimental data available on this subject seem to show that while reinforced concrete structures may, under certain conditions, be injured by the flow of electric current in either direction between the reinforcing material and the concrete, such injury is generally to be expected only where voltages are considerably higher than those which usually occur in concrete structures in practice. If the iron be positive, trouble may manifest itself by corrosion of the iron accompanied by a softening of the concrete, and, if the iron be negative, there may be a softening of the concrete near the surface of the iron, resulting in a destruction of the bond. The former, or anode effect, decreases much more rapidly than the voltage, and almost if not quite disappears at voltages that are most likely to be encountered in practice. The cathode effect, on the other hand, takes place even under very low voltages, and is therefore more important from a practical standpoint than that of the anode.

Structures containing salt or calcium chloride, even in very small quantities, are very much more susceptible to the effects of electric currents than normal concrete, the anode effect progressing much more rapidly in the presence of chlorine, and the cathode effect being greatly increased by the presence of an alkali metal.

There is great weight of evidence to show that normal reinforced concrete structures free from salt are in very little danger under most practical conditions, while non-reinforced concrete structures are practically immune from electrolysis troubles.

(c) Sea Water.—The data available concerning the effect of sea water on concrete or reinforced concrete are limited and inconclusive. Sea walls out of the range of frost action have been standing for many years without apparent injury. In many places serious disintegration has taken place. This has occurred chiefly between low and high tide levels and is due, evidently, in part to frost. Chemical action also appears to be indicated by the softening of the mortar. To effect the best resistance to sea water, the concrete must be proportioned, mixed and placed so as to prevent the penetration of sea water into the mass or through the joints. The aggregates should be carefully selected, graded and proportioned with the cement so as to secure the maximum possible density; the concrete should be thoroughly mixed; the joints between old and new work should be made watertight; and the concrete should be kept from exposure to sea water until it is thoroughly hard and impervious.

(d) Acids.—Dense concrete thoroughly hardened is affected appreciably only by acids which seriously injure other materials. Substances like manure that contain acids may injuriously affect green concrete, but do not affect concrete that is thoroughly hardened.

(e) Oils.—Concrete is unaffected by such mineral oils as petroleum and ordinary engine oils. Oils which contain fatty acids produce injurious effects, forming compounds with the lime which may result in a disintegration of the concrete in contact with them.

(f) Alkalies.—The action of alkalies on concrete is problematical. In the reclamation of arid land where the soil is heavily charged with alkaline salts it has been found that concrete, stone, brick, iron and other materials are injured under certain conditions. It would seem that at the level of the ground water in an extremely dry atmosphere such structures are disintegrated, through the rapid crystallization of the alkaline salts, resulting from the alternate wetting and drying of the surface.

At the request of several manufacturers of hollow tile, a series of investigations of the strength of this material as developed in walls of varying thicknesses has been started in the U. S. Bureau of Standards by the construction of a number of these walls 5 feet long by 12 feet high. The walls so far constructed are of three thicknesses—6, 8 and 12 inches. Those already laid up have been set with the tile placed on their sides. Other variables will enter into the work, and when the investigation is completed about 50 will have been built.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Revolving Barrel as a Mixer

AN oil barrel, suspended by a chain from a light metal frame in such a way that the barrel is revolved about its own axis, is the principal part of an improvised concrete mixer. The mixer is to be used for the small job where a big mixer would be unnecessary, but where hand-mixing would be too slow and expensive to be considered.

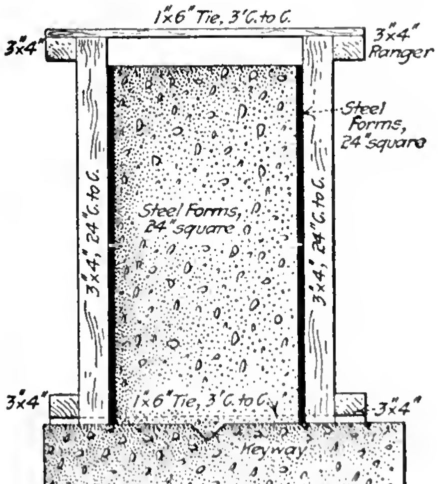
The apparatus is operated by a 1½ horse-power gasoline motor, mounted on a portable carriage. It is especially adapted for the use of farmers or small contractors in laying concrete barn floors, house steps, sidewalks, and the like.

The sand, cement, and stone are shoveled into the barrel in the proper amounts. Then the barrel is revolved about its axis by a belt, driven from the motor, water being added to the mixture during the process. The chain supporting the barrel passes over two trunnion blocks at the top of the frame. These are connected by a bell-crank with a handle, which can be pulled down for unloading.

Ladder Clamps Save Time on Concrete Forms for Low Wall

AN easily erected and removed wall form that has been found very efficient is described by J. G. Grossman, in Engineering News-Record. It is made by supporting Blaw form plates in the manner shown in the sketch. The form can also be made entirely of wood.

After the footing pad was concreted, two long 3 x



4-in. strips were fastened together by spiking 1 x 6-in. ties to them, like the rounds of a ladder. The whole thing was turned upside down and spiked in place to the concrete below, after which the 3 x 4-in. studs shown were erected with the 2-ft. square form plates inside them. These studs were held in place by a second ladder made just like the first one and slipped over the top. In order to strike the form, it was only necessary to remove the top ladder, loosen the studs and take them and the plates out. Only enough pins are used in the steel plates to keep them in place during erection. No wiring is necessary with this form.

Steel Sheeting Sharpened Makes Easier Driving

HARD driving and the presence of various obstructions in the river bottom complicated some deep sheet-pile cofferdam construction of the Louisville Gas and Electric Company. The intake and discharge tunnels for the company's power house extension are being constructed in open trench, within a single-wall cofferdam of steel sheeting driven to a maximum penetration of 65 feet. Arch-web sheeting of Lackawanna type, 14 ins. wide, is used. About half the length of the cofferdam is in the open water, up to 25 feet depth. Both the land and the water portions encountered numerous obstructions—boulders, buried logs, old boat hulls, a large brick-and-stone sewer, and the like. Even in clear soil (clay and fine sand) the driving often was very hard, and the tops of the piles became battered and distorted. To get easier penetration, the sheets still to be driven were sharpened to a chisel edge, by burning with the flame. The interlocks near the point were cut away on a slant, 4 to 6 inches back, and then the edge (3 to 10 ins. wide) was burned to a bevel on the concave side of the sheeting. This expedient, devised by H. W. Fisher, superintendent of construction for the company, proved entirely successful.

Special Forms Permit Light T-Beam Concrete Floor System

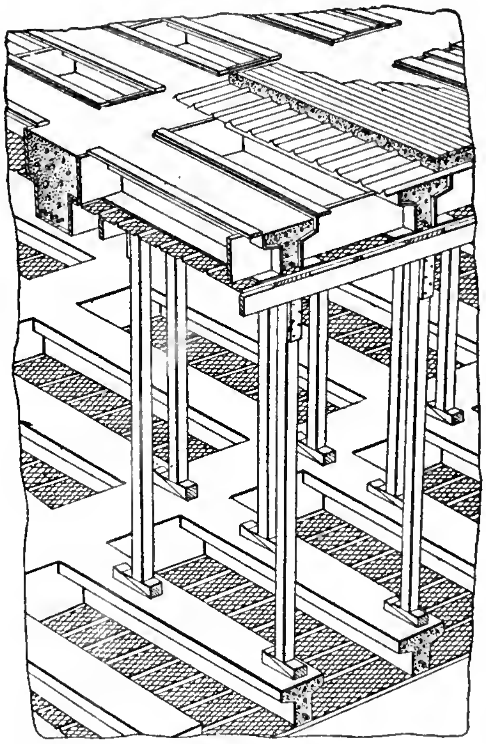
IN the new building now being erected for the Federal Trade Commission at 15th and K Streets, N. W., Washington, D.C., a new type of reinforced-concrete floor has been placed at what the designers claim to be a considerable saving in weight and hence in cost over any other fireproof floor of equal strength. The design is controlled by patents held by the T-Beam Engineering Company, of Washington.

The floor, as described in Engineering News-Record, consists of rows of small concrete beams or joists of T-shape poured monolithically with their supporting beams or girders between forms made up of spacing members or boxes of wood and cores of bent sheet metal. The accompanying perspective shows the general layout of the system, which may be used either on steel-frame or in reinforced-concrete buildings. The new building at Washington is of reinforced concrete.

Construction Details

In building the floor, a line of struts is placed in each lower T-beam and capped with plank that serve as beam bottoms. On these plank as joists is then laid expanded or ribbed metal that forms a ceiling base. Then metal forms bent to the shape of one side of the T-beam are placed over each plank and held in position by properly cut brace boards between beams and by stiffener planks along the top. In the T-form thus made, the proper reinforcing is placed and the concrete poured to make the T-beam.

When these beams have set, the bracing boards are knocked out and the beam metal forms released to be



taken upward and used on the next floor above. The beams are then overlaid with another sheet of expanded metal, and the usual cinder concrete floor is placed. For the upper (floor) layer a fireproof board could be used in place of expanded metal.

In the Washington building the beams are 28 ins. centre to centre with stem 6 ins. deep and 4 ins. wide and with flange 11½ ins. wide and 2½ ins. deep. This leaves a 17-in. opening between flanges, which is spanned by the 3½-in. cinder-concrete floor unreinforced except for the expanded-metal base. The metal forms are of No. 24 gauge sheet iron and were turned out to proper shape by a local tinsmith.

The basement columns of the building were poured March 11, 1917, and the last of the roof concrete was placed May 19, 1917, the twelve floors and roof, all 35 x 103 ft. in plan, being completed in that time. This allows about 4.3 working days per floor.

Curing Concrete Pavements

SATISFACTORY results are still being obtained in California (where the method originated) of curing concrete pavements by keeping them flooded with water retained by earth dams built across and along the pavement.

After finishing, the concrete is covered with canvas until it has hardened sufficiently to permit building earth dams across the pavement generally at joints and along edges. If there is a curb, longitudinal dikes are unnecessary. Where there is no curb two such longitudinal dikes are better than one along each edge, especially on wide streets, as loss of water from breakage of dikes is less likely.

Flooding is done in the evening when water is not needed for the mixer, and is kept at a minimum depth of 2 inches at the crown for about ten days.

This method resulted from an endeavor to devise a better and cheaper way of curing concrete pavements than by covering them with earth, especially in hot, dry climates. It economizes water used because loss by evaporation is not as rapid as from the wetted earth covering, the porosity of which exposes greater surface for evaporation.

Another economy is that there is but very little earth to be removed from the pavement afterwards.

The ponding method generally produces better results than are secured with an earth covering.

Why Hot Water Pipes Freeze More Quickly Than Cold

IT is a constant observation that during a sudden cold snap hot water pipes burst, while the cold water usually freezes up tight without rupture of the pipes carrying it. A French experimenter has recently looked into the cause of this. He finds that the hot water invariably falls to several degrees below zero Centrigrade before beginning to solidify, and that the ice then formed is perfectly solid and transparent. Ordinary cold water, on the other hand, begins to congeal as soon as the "freezing point" is reached; that ice is filled with air bubbles, and presents a soft and mushy appearance.

The explanation is that the air and other impurities in ordinary water furnish nuclei of crystallization. Ice formation thus begins sooner and proceeds more slowly than if these were absent; and the ice formed is more mobile, so that pressures are not so severe. Hot water, however, is to a large extent free of gas particles, which have passed off during the process of heating, so this effect is not observed. Freezing does not take place gradually, but all at once, with somewhat of an explosive effect; and there is no cushion of gas bubbles to take up the shock. That this explanation is correct is indicated by the fact that when a current of air is forced through the hot water just before freezing, it behaves in every detail just like cold.—Scientific American.

Large Rock Crusher

The biggest rock crusher in the world has just been built and put in operation by a firm of New York contractors. This crusher will take blocks of limestone 30 feet long. It has a capacity of 25,000 tons of stone a day. To fill it a single time 65 tons of rock are required. The crusher is 34 feet high, about the height of a two-storey building. It is driven by a 300 horse-power motor The belt which turns the three-foot shaft is somewhat unusual, in that it consists of eighteen manila ropes, each 1½ inches in diameter. By the use of these ropes continuous operation is guaranteed, since if half of them break the other nine ropes are enough to keep the machine running, and repairs can be made without stopping.

Mainly Constructional

East and West—From Coast to Coast

Woodstock, N.B., contemplates the installation of a mechanical sand filtration plant. The project will be submitted to the ratepayers on August 10.

The new technical school in London, Ont., is being rushed to completion. The roofing is going on, and it is expected that the building will be ready for occupation in the month of September.

Work has recently been started on a new bridge in Newmarket, Ont., on Huron Street. A temporary bridge is in place and excavation has been commenced for the piers of the new structure, which will be of concrete and steel, over 100 feet in length.

During the month of June building permits were issued in the city of Woodstock, Ont., to the amount of $2,435, as compared with $1,828 in the same month last year. For the first six months of 1917 the total value of permits issued is $53,867, as against $44,606 during the corresponding period in 1916.

The building permits issued in the city of Chatham, Ont., during the month of June total $150,000, showing a big increase over the same month last year, when the total was $62,550. Permits for the first six months of the year amount to $186,445, as compared with $156,170 for the corresponding period of 1916.

During the month of June there were 191 permits issued in the city of Montreal at a value of $357,745, as compared with 207 permits issued in the same month last year at a value of $748,050. From January 1 to June 30, the total is 861 permits valued at $2,466,659. This compares with 950 permits at a value of $2,434,344 for the corresponding period in 1916.

Permits issued in the city of Vancouver, B. C., during the month of June number 39, and are valued at $42,555. This compares with 41 permits at a value of $42,720 in the same month last year. For the first six months of the year, the total is 261 permits valued at $303,894, as against 234 permits during the corresponding period in 1916, at a value of $434,050.

It was decided at a recent meeting of the Board of the Greater Winnipeg Water District to continue work on the Shoal Lake Aqueduct. Three million dollars in 5 per cent. 5-year gold bonds will be placed on the market by the District. It was intimated at the meeting that the line of the aqueduct would not be extended but that efforts would be made to complete the work in the excavations made before fall.

Hon. F. G. Macdiarmid, Minister of Public Works for Ontario, announces that arrangements have been made for a short course in highway construction to be taken up at the fall term of the Ontario Agricultural College. Lectures will be given by members of the staff of the highway department. The course will cover road development, growth of traffic, economic value of roads, road drainage and grading, road foundations, maintenance, etc.

That the Province of Manitoba is not behind in road construction work is shown by the action of a number of the municipalities. The rural municipality of Portage la Prairie has, with the approval of the Good Roads Board, adopted a scheme which will involve the expenditure of $300,000. This undertaking will furnish the municipality with a large number of main market roads and nearly thirty miles of the main provincial highway, the total mileage being 231. Nine bridges will be included in the project, and these will cost some $23,000. The municipality of St. Francois Xavier is building a gravel road under the Good Roads Act, from the end of the asphalt road at Headingly to Poplar Point. Here Portage la Prairie will take up the work and carry it on to the western limits of the municipality at Burnside. It is expected that the municipalities to the west will fall into line later and carry the road to Elkhorn, at the western boundary of the province, and through the city of Brandon and the towns of Carberry, Oak Lake, and Virden. Swan River rural municipality also has a scheme to construct a road system, at a cost of $41,645, and St. Clements projects 8½ miles of gravel road, to cost some $8,864.70.

The British Columbia Telephone Company have closed a contract with Messrs. Adkinson & Dill for the completion of the steel framework of their building on Seymour Street, Vancouver, which has been standing in an unfinished state since shortly after the outbreak of war. It is intended to use the building when completed for the central exchange. In it also will be located the contract and recording and other business departments and the offices of the various departmental officials of the company. The plans call for a nine-storey structure. The front of the building, for the first two or three storeys, will be finished with native granite, and the balance with Roman pressed brick. On other portions of the structure pressed brick and enamelled brick will be used, while the top storey will be covered with terra cotta. On the roof a garden will be laid out for the benefit of the employees. The main interior, entrance court, and chief offices will be finished with oak and marble. Construction is to be recommenced at once. The cost of erection already amounts to $75,000, and another $90,000 will be required. The steel framework has been protected during its three years' exposure by a weather-resisting coating.

Personals

Mr. N. B. Davis, formerly assistant engineer in the Ceramic Division, Mines Branch, Ottawa, has opened an office as consulting geologist at Kingston, Ont.

Mr. Alexander Forbes Proctor, a graduate of Aberdeen University, has been appointed chief engineer of the British Columbia Provincial Department of Railways, in place of Mr. F. C. Gamble.

Lieut. W. M. Goodwin, of the Canadian Engineers, has been awarded the Military Cross. Lieut. Goodwin is the son of Dean W. L. Goodwin, of the Engineering Department, Queen's University, Kingston.

Mr. J. White, of the ornamental iron department of Canadian Allis-Chalmers, Limited, has been appointed general superintendent of the Canada Foundry Company's Davenport works, taking the place of J. J. Scollan, who recently resigned.

Obituary

Mr. Wm. Geo. Beaver, of Hamilton, Ont., died recently at his home in that city. Mr. Beaver was born in Peterboro, England, 77 years ago, and for the past forty years had resided in Hamilton, where he carried on a contracting business.

Mr. Chas. W. Drysdale, of Ottawa, chief of the geological survey party, met his death recently in British Columbia when a raft on which he was attempting to cross the Kootenay River, near Cross River, upset. Two others, Wm. J. Gray, of Vancouver, and Geo. Smith, were also on board the raft. The former was drowned, but the latter reached shore.

Tenders and For Sale Department

Judicial Sale by Tender
of the Assets of
Kirkfield Portland Cement Company, Limited

in the Supreme Court of Ontario

Shortreed vs. Kirkfield Portland Cement Company, Limited

Pursuant to the judgment made in this action and with the approval of J. A. C. Cameron, Esquire, Official Referee, tenders will be received up to twelve o'clock noon of Thursday, 26th July, 1917, addressed to J. A. C. Cameron, Official Referee, at the office of G. T. Clarkson, Receiver, 15 Wellington Street West, Toronto, and marked "Tenders re Kirkfield Portland Cement Company, Limited," for the purchase of the following assets of Kirkfield Portland Cement Company, Limited, namely:—

Real Estate, being in the Townships of Bexley, Laxton and Somerville, Victoria County, Ont.

Parcel 1—Real Estate and Cement Plant.

A. Mill site, about 12½ acres.

B. Ranch, about 98 acres.

C. Dry marl bed, about 50 acres.

D. Land opposite mill site, about 7 acres.

E. Marl bed under Raven Lake, about 354 acres; together with the buildings, erections, plant and machinery situate on Parcel A. Full descriptions of the several parcels are to be seen in the office of the Receiver, G. T. Clarkson, 15 Wellington Street West, Toronto.

Parcel 2—Water Power and Power Plant and Transmission Lines.

A. Lot A, Concession B, Somerville.

Lot B, Concession A, Somerville.

Lot 9, Concession 11, Laxton, excepting 1 acre heretofore sold by A. Hastings, containing about 148 acres and subject to the reservations as to Government rights set out in the mortgage of 30th December, 1910, made by Kirkfield Portland Cement Company, Limited, to National Trust Company, Limited, in the pleadings mentioned, together with buildings and machinery comprising power plant; also transmission lines.

B. Lot D, Concession A, Somerville, and part of Lots 6 and 7 in Concession 11, Laxton, containing about 143 acres, subject to said reservations as to Government rights. It is estimated that on this property an additional 300 H.P. could be developed.

Parcel 3—Stores, Supplies, etc., as per inventory, which may be seen at the Receiver's office.

Parcel 4—Office Furniture, as per inventory, which may be seen at the Receiver's office.

Tenders will be received for the purchase from the Receiver of the whole of above described property en bloc, or in the alternative for the purchase of Parcel 2, known as the Water Power and Power Plant, etc., and for the separate purchase of the said Parcels 1, 3, and 4, with the buildings, plant and machinery thereon, together with equipment and supplies.

Intending tenderers may obtain particulars of the terms and conditions upon application to the Receiver, G. T. Clarkson, 15 Wellington Street West, Toronto.

Tenders will be opened by the Official Referee, or the Receiver at the Receiver's office, 15 Wellington Street West, Toronto, on Friday, the 27th day of July, at eleven o'clock in the forenoon, when all tenderers are requested to be present.

The highest or any tender not necessarily accepted.

A marked cheque for ten per cent. is to accompany each tender. Upon acceptance of any tender fifteen per cent. of the purchase price, in addition to the marked cheque of ten per cent. accompanying the tender, shall be paid forthwith. Twenty-five per cent. in addition shall be paid within thirty days thereafter and the balance upon the completion of the sale.

In the event of acceptance of a tender, the property shall be forthwith insured and the premium paid by the purchaser, and the property shall be kept in repair by him, taxes and insurance to be apportioned as of the date of acceptance.

The purchaser shall search the title at his own expense, and the vendor shall not be required to furnish any abstracts or copies of them or to produce any deeds, declarations or other evidences of title, other than those in his possession. The purchaser shall have ten days in which to make any objections or requisitions, and if the Receiver shall from any cause be unable or unwilling to satisfy them he may, notwithstanding any intermediate negotiations, rescind the sale, in which case the purchaser shall be entitled only to a return of the deposit money, without interest, costs or compensation.

In case of default by the purchaser, after notice, the Receiver may declare the deposit forfeited.

In the event of a sale, possession will be given upon payment of the said fifty per cent. of the purchase money.

The other conditions of sale will be the standing conditions of the Court.

Full particulars of the property, machinery and all other details can be had upon application to G. T. Clarkson, 15 Wellington Street West, Toronto, or to Messrs. Cassels, Brock, Kelley and Falconbridge, Vendor's Solicitors, 85 Bay Street, Toronto, or to Messrs. Royce, Henderson and Boyd, Traders Bank Building, Toronto, or to Messrs. Blake, Lash, Anglin and Cassels, 25 King Street West, Toronto.

June 29, 1917.

CASSELS, BROCK, KELLEY AND FALCONBRIDGE,
85 Bay Street, Toronto,
Vendor's Solicitors.

28-29

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Metallic Fittings No. S-1760," will be received until 4 p.m., on **Wednesday, July 25, 1917**, for the supply of Filing Sections for Dominion Public Buildings, Ottawa.

Plans, specifications and forms of contract can be seen and forms of tender obtained on application to the office of the Caretaker, Post Office, London, Ont., the Overseer of Dominion Buildings, Post Office, Montreal, the Clerk of Works, Postal Station "F," Toronto, and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returnd.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, July 12, 1917.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.
29-29

Tenders for Drain

Tenders will be received up to 12 o'clock noon, **August 20th**, for the construction of a ditch, under "The Municipal Drainage Act," in the 1st, 2nd and 3rd Concessions of the Township of Greenock, in the County of Bruce.

Length of drain about three and a third miles. Clearing willows, slash, and bush and estimated excavation of 15,500 cubic yards.

Engineer's report, plans and profile may be seen at the clerk's office, Lot 15, Con. 14, Greenock.

Council will meet at Chepstow on Monday, August 20th, to open and consider tenders. The lowest or any not necessarily accepted.

THOS. H. PURDY,
Clerk of Greenock,
Glamis P. O.
R. R. 1. Ont.

Dated July 10th, 1917. 29-32

Derrick For Sale

McMyler Rotating Self Propelling Derrick, 50 ft. Boom for handling clam, steel under frame, good condition, convenient for lake shipment. Photo and price on application. Box 597, Contract Record, Toronto, Ont. 28-30

For Sale
MOTORS and PUMPS

2 centrifugal pumping units complete as follows:—2—24-in. Suction, 24-in. Discharge centrifugal pumps direct connected to Canadian Westinghouse induction motors, Type H.F., Constant Speed, 750 H.P., 2200 Volts, 25 Cycle, 3 Phase, 175 Amp. per terminal, 292 R.P.M., complete with circuit breaker and starter.

These units are practically new and have received good care and can be purchased as a whole or in part.

CANADIAN STEWART CO., LTD.,
Dominion Bank Building,
28-31 Toronto, Ont.

For Sale

$600,000.00 Worth of Released Machinery Consisting of

2,000 cu. ft. Compressors—400 H.P. Motor. 5—1186 cu. ft. Compressors 225 H.P. Motor. Aftercoolers, 2-ton Alco Truck, 7-ton Commer Truck, Air Re-heaters, Air Receivers, Woodworking Machinery, Round and Square Ore Buckets, Root Blowers, Rock Sand Dump Cars, Cement Guns and Grout Machine, Travelling Cranes, Rock Crushers and Elevators, Drills (Sullivan & Hardy) Transformers (500 K.V.A.) Generators, Derricks, Electric Hoists and Hoisting Engines, Shaft Cages, 8 Electric Locomotives, Concrete Mixers, 25 Motors, Dresser Joints, 10 Centrifugal Pumps, 400 tons 40 lb. Relaying Rails, 1,000 Gals. Creosote Oil, etc.

The above constitutes a few only of the various articles for sale.

Apply or write to,

CHAS. C. LABRIE, P.A.
Mount Royal Tunnel & Terminal Co., Ltd.,
411 Dorchester Street West,
28-31 Montreal, Que.

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Vol. 31 July 25, 1917 **No. 30**

Principal Contents

Briquettes for Fuel

A SPECIAL meeting of the Saskatchewan branch of the Canadian Society of Civil Engineers was held in Regina on July 12, on the occasion of the visit of the members of the Advisory Research Council—Dr. Macallum, chairman; Dr. Ruttan, and Dr. Adams. Dr. Macallum also addressed the Canadian Club of Regina on the same day.

The members of the Advisory Council were the speakers at this special meeting, and outlined in detail the work this council has in hand toward conserving and developing the industrial resources of Western Canada; particularly, at the moment, they are considering the utilization of the coal fields of Saskatchewan by the manufacture of briquettes, which will take, in very considerable measure, the place of anthracite coal. It was stated that these could be manufactured for about $8 per ton laid down in Regina, as compared with anthracite at $11 or $12. It was also stated that the council had made a request to the government for a grant of $400,000 to construct a briquetting plant, to be located at a point in the province to be later determined. If the Dominion Government refused this request the matter would be taken up with the local governments, and it was hoped that the production of briquettes would be undertaken in the near future. This sum of money would be sufficient to establish a plant capable of producing 30,000 tons of briquettes per annum.

How Materials Withstand Heat

ONE of the subjects discussed at the recent convention of the American Society for Testing Materials was that of the heat-insulating properties of materials used in fire-resistant construction. A paper was presented by Mr. W. A. Hull giving results of experiments. The materials included in the investigation were: (1) Clays that are used in the manufacture of hollow tile fireproofing; (2) concretes, including two proportions of a number of aggregates; (3) gypsums, including specimens from three manufacturers prepared from mixtures differing in kinds of filler and in ratio of plaster to water; (4) one specimen of lime mortar; (5) one specimen of a new material. In most cases three specimens of each material or mixture were tested.

The results of the various tests were described and a number of interesting illustrations produced, and the author reaches the following conclusions:

Conclusions

The tests as a whole indicate that there is not a very great difference among concretes from the aggregates commonly used, in respect to the protection that would be afforded to steel reinforcement embedded in concrete near the surface, assuming that the concrete protection did not come off and expose the reinforcement. It would not be wise to draw conclusions on that point from this work. As to protection of steel members, the insulating properties of the denser clays are indicated to be inferior to the more porous clays and to the concretes. It is to be noted in this connection that this work deals exclusively with solid materials, and it is not attempted to draw comparisons between hollow blocks or tile of one material and a solid mass of another. The more porous clays compared fairly well with the concretes. It should be stated that the porosity of the more-porous clay specimens was undoubtedly due in part to lighter burning in the kiln.

Gravel concretes gave particularly unfavorable indications. While the ground covered in this work alone is by far too narrow to permit of drawing hard and fast conclusions, the indications are consistent with the results of other investigations. There is strong evidence that some gravels, at any rate, are distinctly inferior for concrete for fire-resistive construction. Cinder concretes are apparently to be viewed with suspicion, especially if the cinders contain much combustible material, which is apt to be the case with cinders from bituminous coal. No anthracite cinders were included in this investigation.

Gypsums made good heat-retarding records, but were very soft and weak after test. There was a favorable showing made by the denser, as compared with the more-porous mixtures, which is consistent with theoretical considerations.

The Perth Contracting and Manufacturing Company, Ltd., has been incorporated, with a capital of $60,000, head office at Stratford, Ont. This company will take over the businesses now carried on in Stratford by Schmidt Brothers, Avon Plumbing and Heating Company, and Dunham & Box.

What Highway Maintenance Costs

SOME useful figures on the cost of maintenance, repair, and reconstruction of county highways are contained in the annual report of the Commissioner of Highways for the State of New York, covering the calendar year 1916. The work, done with departmental equipment, labor, and material, included the following items:

Maintenance by the patrol system of 5,459 miles of low-grade concrete and macadam pavements and gravel surfaces, $654,746; light surface treatment of 423 miles of low-grade concrete, macadam, and gravel, $85,810; restoring in a permanent manner 243,880 square yards of macadam which had broken through under traffic during the spring, $326,400; making extraordinary repairs caused by cloudbursts and floods, $71,042; making miscellaneous repairs to pavements, shoulders, and gutters, with gangs, 2,600 miles, $772,628.

The following table summarizes the total expenditures for maintenance and repairs on the various types of roadways:

Expenditure Per Mile During 1916, for Maintenance and Repair, Exclusive of Reconstruction to Different Types

Type of improved surface	
Block pavements:	
Brick	$176.00
Asphalt	78.00
Wood	52.00
Stone	46.00
Brick cubes	188.00
Concrete:	
First-class	141.00
Second-class	1,080.00
Hassam	412.00
Bituminous macadam:	
Mixing method:	
Amiesite, concrete base	148.00
Amiesite, macadam base	112.00
Topeka, concrete base	205.00
Topeka macadam base	256.00
Open mixed, concrete base	117.00
Open mixed, macadam base	686.00
Bithulithic, concrete base	150.00
Henderson, macadam base	1,769.00
Gravel, mixed gravel base	300.00
Penetration method:	
Asphalt binder	493.00
Tar	234.00
Sub-base bituminous surface	681.00
Water-bound macadam	906.00
Gravel	587.00
Kentucky rock asphalt	331.00
Roemac	532.00

The Burrard Quarries and Construction Company, Ltd., has been incorporated, with a capital of $100,000, headquarters at Vancouver.

Judgment Upheld

THE Court of Reviews, Montreal, has upheld the judgment of the Superior Court in annulling a contract for building a church, between Henri Tessier, Fils, and the church vestry board of the Parish of Notre Dame du Perpetual Secours. Owing to the war, Mr. Tessier was ordered to suspend all work, and the parish board declined to allow it to be resumed, on the ground that it was impossible to obtain the necessary money. The Superior Court held that this was not a legitimate cause for the suspension of the work, and annulled the contract, awarding plaintiff $40,006 damages. The Court of Reviews, while upholding this decision, reduced the damages to $26,787.

To Study France's Rebuilding Problems

The French Journal Official publishes an order of the Minister of the Interior constituting a committee of fifteen members, to be known as the "Commission Consultative des Marches et des Stocks," the duty of which will be to study administrative and technical questions in reference to contracts for purchasing stocks of provisional houses and materials for provisional and final reconstruction work in invaded districts of France. The committee will also take charge of and oversee stocks of houses and material furnished. Monsieur Ogier, Conseiller d'Etat, Directeur du Controle et de la Comptabilite, Ministere de l'Interieur, Paris, has been named president of the committee.

Cost of Motor Truck Operation

Mr. Frank T. Sheets, assistant maintenance engineer Illinois State Highway Department, in a recent item in Engineering and Contracting, states that the Illinois State Highway Department now has in operation five small maintenance trucks, which are used in keeping up the widely-scattered mileage of state-aid roads in Illinois. The principal work consists of filling cracks in concrete roads.

Truck No. 1 is an ordinary Ford runabout, fitted with a box for hauling material. This truck pulls a trailer, which carries a heating kettle and miscellaneous tools. Trucks No. 3 and No. 5 are also Ford runabouts, to which small boxes and heating kettles have been attached. Trucks No. 2 and No. 4 are Ford cars fitted with Form-a-Truck attachments. All of these cars have proved very efficient in performing the class of work required of them.

The accompanying table gives the mileage and the cost of operating these machines from the beginning of this spring to May 35. The heading "total cost of operation" includes all incidental repairs, but does not include salary of operator, interest on the investment, depreciation, or the first cost of tires. Experience indicates that the cost of tires will average about $5 per tire per 1,000 miles' run.

Report of Truck Operation from Start of Season of 1917 to May 26

Truck No.	Type of truck	Mileage previous to this season	Mileage this season	Gasoline used Gallon	Gasoline used Cost	Miles per gallon	Gasoline cost. Cts. per mile.	Total cost of operation	Total cost of operation Cts. per mile.
1.	Ford with trailer	13,265	1,926	118	$28.75	16.3	1.49	$76.71	3.98
2.	Smith Form-a-Truck:								
	Engine	6,000	1,821	139.5	31.73	13.1	1.74	67.09	3.68
	Truck attachment	0							
3.	Ford	4,015	1,376	143	28.61	9.63	2.08	62.03	4.52
4.	Smith Form-a-Truck	0	1,293	141	27.85	9.18	2.16	45.06	3.49
5	Ford	0	2,300	151	30.52	15.2	1.33	55.27	2.40

Deep Open Cut on Montreal Terminal

C. N. R. Enters Montreal by Tunnel and Heavy Open Cut Requiring Special Methods of Excavating and Mucking — Viaduct Across Cut

THE new terminal of the Canadian Northern Railway in Montreal will be situated in the two blocks bounded by Cathcart, St. Monique, Lagauchetiere, and Mansfield Streets, two blocks from the C.P.R. Windsor Station and six blocks from the Grand Trunk Bonaventure Station. Approach to the terminal will be via the new three-mile double track tunnel through Mount Royal, the east portal of which is at Cathcart Street (see Fig. 1). From Cathcart Street east the tracks and platforms will be in open cut the two tracks from the tunnel feeding into five tracks, with stub ends at the station building, which will be located at the westerly corner of Lagauchetiere and St. Monique Streets. The tracks in open cut are crossed by only one street—Dorchester Street West—which is carried overhead on a steel viaduct.

The terminal will have five tracks, four of which will be devoted to passenger traffic and one to mail and express service. The elevation of track subgrade is 144.4, and is level throughout. Grade of the tunnel is 0.6 per cent. going west, and meets the level terminal grade with a vertical curve 400 feet long. The depth of subgrade below present street elevations is 38 feet at Cathcart, 50 feet at Dorchester, and 19 feet at Lagauchetiere Street. At the tunnel portal the top of rock is 16 feet above subgrade, and slopes down towards the east so that rock surface passes below subgrade about 300 feet east of Dorchester Street.

Concrete Retaining Walls to Shorten Slope

The face of the rock in the cut will be 8 feet 6 inches from the centre line of the track. A 2-foot berm will be left on top of the rock and a 1:1 slope given to the earth slope, which will be covered with an 18-inch layer of heavy rip-rap, using the rock blasted out of the cut. Wherever the slope above the top of rock would run out into St. Monique Street or on to private property on the southwest side, concrete retaining walls will be placed at the bottom, with sufficient height that the slope will end one foot from private property. The highest wall is required on the south side, extending from the station building, a distance of 200 feet, varying in height from 21.5 feet to 28.5 feet Track A, or the north track nearest St. Monique Street, will have a 12-foot platform. Tracks A and B are 13 feet centres; tracks B and C are 29 feet 6 inches centres, with a 19-foot platform between them; tracks C and D are 13-foot centres, and tracks D and E are 29 feet 6 inches centres, with a 19-foot platform between them; and on the other side of Track E is a 10-foot platform. The 12 and 19-foot platforms are for passenger service, and the 10-foot platform on the south side of the terminal is for mail and express service exclusively. The top of rail is 2 feet above subgrade, and the top of platforms is 1 foot above top of rail. The edge of platforms is 5 feet 3 inches from centre line of track. Umbrella train sheds will extend from the station building to the west end of platforms. The whole terminal will be electrified, using 2,400 volts d.c., the same as in the tunnel, power being supplied from the new sub-station at the west portal of the tunnel. An overhead catenary system will be used throughout, with spans of 90 feet between cross-spans supported by steel poles. The trolley wire will be 16 feet above top of rail. Six 85-ton electric locomotives will handle the traffic between Cartierville and the terminal at the beginning of operation. The rails used are 90-pound A.R.A. type A, with tie-plates and screw-spikes. No. 9 frogs are used throughout, except where space required a No. 8 to be used, and one No. 7 is used at the siding for coal cars at the boiler-house.

Separate Contracts for Station Building and Excavation

Separate contracts were let for the Terminal Station Building and the terminal excavation. The station building contract includes excavation for the building and ramps only, and the terminal excavation contract is for the removal of earth and rock from Cathcart Street to end of ramps. Description of the work is, therefore, divided, the description of excavation being for the excavation contract only.

The total amount to be excavated was 250,000 cubic

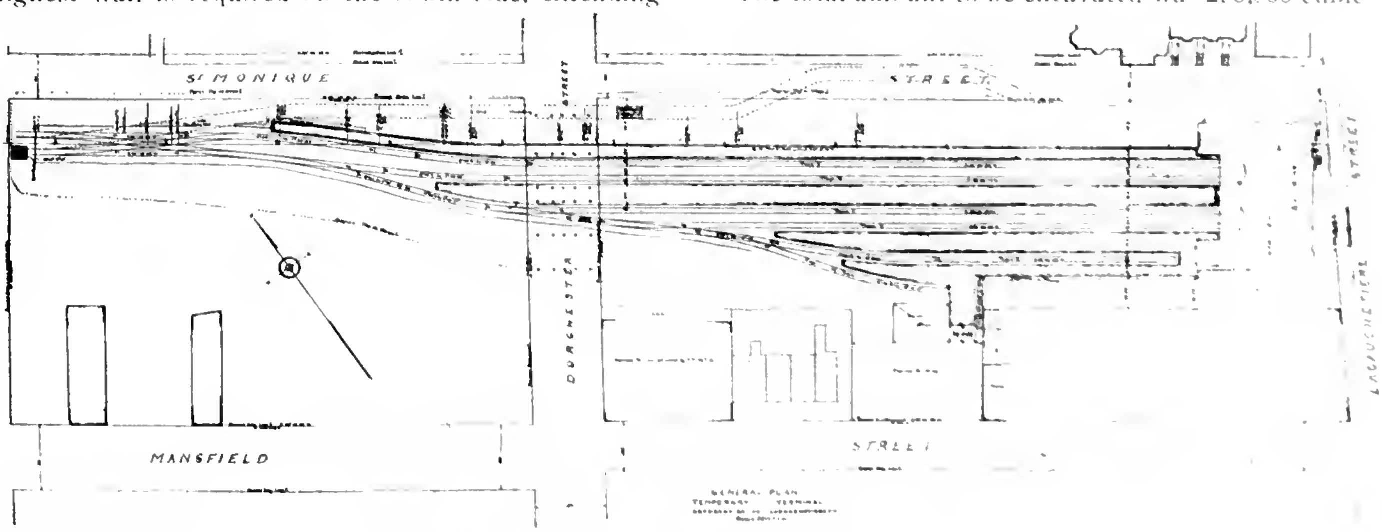


Fig. 1—General plan of C.N.R. terminal facilities at Montreal. East portal of tunnel is at Cathcart St. Tracks to east of tunnel are carried in an open cut.

yards of earth and 18,000 cubic yards of rock. The tunnel had been driven from the foot of a shaft 50 feet deep at Dorchester Street, and the muck from the tunnel was brought up this shaft and dumped on adjacent property, so that there was a large spoil bank of broken rock and clay included in the above quantities. The tunnel has been completed and lined with concrete from Cathcart Street to the portal on the west side of Mount Royal. From Cathcart east to Lagauchetiere Streets runs the old tunnel heading, 8 feet x 12 feet. A second shaft had been sunk near Cathcart Street for handling concrete blocks into the tunnel when the latter was being lined, and it was decided to use this shaft for dumping material excavated from the station site into cars below, until the excavation had proceeded to a sufficient depth to allow the muck trains to run directly into the tunnel after being loaded. A chute was made at the bottom of the shaft, and two platforms built across shaft, acting as baffles to prevent large boulders from descending too rapidly. The tunnel at this place has two tracks with a wall between, the shaft being over the south track. At the foot of the Cathcart Street shaft the old heading was enlarged so that a 12-yard car when loaded could be pulled back and ready for material. Material is loam and boulder clay, which, when wet, slows up the excavating considerably.

Sewer Causes Difficulty in Excavating

The excavation is made more difficult to handle by a double 4-foot cast iron sewer at Dorchester Street, about 500 feet from the portal. The sewer is about 20 feet below street elevation and 30 feet above subgrade. The sewer originally was a 5-foot brick sewer, but was changed last winter into two 48-inch C.I. pipes, so that it could be suspended from the Dorchester Street viaduct.

Passage Into Tunnel Will Facilitate Work

The No. 20 shovel is being used in the block between Cathcart and Dorchester Streets to cut down to rock so that a passage into the tunnel can be made as soon as possible; the No. 60 shovel is between Dorchester and Lagauchetiere Streets, where the larger quantity of material has to be removed. The sewer at Dorchester Street makes a steep grade necessary for the loading track until the small shovel cuts through under the sewer pipes.

As soon as the No. 20 shovel uncovers the rock near the Cathcart Street portal the rock will be removed

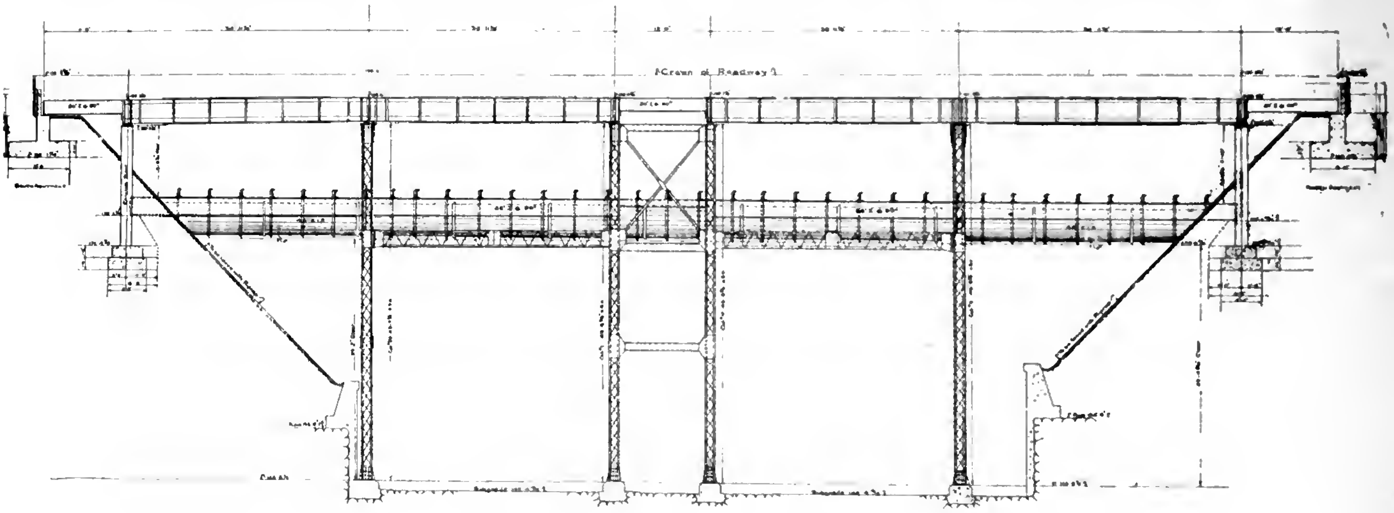


Fig. 2—Dorchester street crosses open cut by viaduct of plate girder spans on steel columns.

switched over into the north tube. A narrow-gauge, 10-ton locomotive, formerly used in the tunnel construction, moves the loaded cars from the track in the south tube to that in the north tube, where the outgoing muck train is made up.

Excavation Equipment

The excavation equipment is (1) on the surface—One No. 60 and one No. 20 Marion steam shovel, three 20-ton dinkeys, and eighteen 6-yard side dump-cars; (2) in the tunnel—Three 85-ton electric locomotives, using 2,400 volt d.c., and three trains of 12 side dump-cars, each of 12-yard capacity, and one 10-ton electric locomotive mentioned above. Work is done in two 10-hour shifts.

Material is loaded by steam shovels into the 6-yard cars, and these are brought to the Cathcart Street shaft and dumped into the 12 yard cars in the tunnel. The material is then hauled through the tunnel and out to Cartierville, about five miles beyond the west portal of tunnel, and used to make a fill for a yard at that place. It was found impossible to use a door at the bottom of the shaft, as the material clogged in the chute. Therefore, no cars are dumped until a signal is given that the 12-yard receiving car at the bottom is and a passage made for the muck trains to run into the tunnel after being loaded. The 12-yard cars will then be hauled directly to the shovels, to be loaded, instead of receiving the material from the shaft. This will facilitate the work of excavation considerably. The electric locomotives which haul the muck trains through the tunnel will not run out into the open cut, but the cars will be hauled to and from the steam shovels by the 20-ton dinkeys. This eliminates accidents due to the high-voltage trolley wire.

Steel Viaduct Across Cut

As mentioned before, the open cut is crossed by one viaduct. This is a steel structure, with short plate-girder spans supporting the steel and concrete deck, carried on steel columns (see Fig. 2). The city required that traffic be kept open on part of the street during construction, so the viaduct is being erected in two parts. The sewer mentioned before was finished in February, 1917, and work was immediately started on sinking shafts for the centre and two west side columns of the various bents. These shafts were sunk to the required depth, two feet below subgrade, and the concrete footings poured. All the west side columns were then put in place and the three south spans erected and deck concreted. The north end of the bridge could not be put in place, as there was not clearance between the top of the sewer pipes and bottom of the street girders for the dinkeys and muck trains. A temporary timber structure was put in place for west side of bridge for these spans until the shovel had progressed far enough to pass under the sewer pipes. While the steel and timber structures were being erected on the west half, shafts were sunk for the east side columns. The material was removed from the shafts

Fig. 3—Steam shovel making cut.

and the steel work erected, with the use of one stiff-leg derrick with 50-foot boom.

The sewer pipes are hung from separate beams below street level and are supported every four feet by hangers.

Load Provisions on Viaduct

The viaduct carries two street car tracks in a roadway 40 feet wide and two 12-foot sidewalks. It was designed for two 100,000-pound cars L.L., on each track, with 25 per cent. impact; a 20-ton truck on roadway with 25 per cent. impact, and 125 pounds per square foot on sidewalk without impact. The concrete in deck and end bends is of 1:2:4 proportion, and 1:2½:5 in the abutments.

The roadway of the viaduct is of reinforced concrete, waterproofed, with two layers of burlay and felt, covered with a protective coating of 1 inch of asphalt mastic. The waterproofing fabric is buried in curb to make a water-tight joint at edge of roadway.

The viaduct is on a slight skew, due to the platforms below not being at right angles to centre of Dorchester Street.

Station Building of Concrete Construction

The station building will be a concrete structure, with stucco finish, 135 feet by 106 feet, with two storeys above street level and one below. On the main floor at street elevation will be the ticket office, main waiting-room, baggage-room, etc., with stairway leading below to a concourse and track level. The upper floor will be devoted to a dining-room and offices.

Ramps descend from concourse to train platforms, which will be one foot above top of rail for the present, but high platforms level with the concourse in the future development.

The excavation for the station was done with a No. 18 Bucyrus revolving shovel, and the material hauled out by teams. Foundations were carried to rock about ten feet below concourse floor level in trench excavation.

The station will be completed about November 1, 1917.

Heating Arrangements

The station building will be heated by two 60 h.p. boilers, located in a boilerhouse south of the tracks. This boiler-house will be at track level, 43 feet below Mansfield Street level. Besides heating the station it will also have separate boilers for supplying steam to the cars while they are standing in the station. The rear wall of the boiler-house will act as a retaining wall, supporting the foundations of the express building, which will be at street level on Mansfield Street.

The express building will have freight elevators to a platform below at the same elevation and connecting with the 10-foot platform at Track E (see Fig. 1). The mail service will also be handled in this building.

Personnel

The station building was designed by Warren & Wetmore, of New York City, and its erection, together with that of the boiler-house and express building, is in charge of George C. Briggs, supervisor of buildings, C.N.R.

The Norcross Brothers Company, Montreal, are general contractors for the station building.

The terminal excavation is being done by Angus Sinclair, and all other parts of the work, including via-

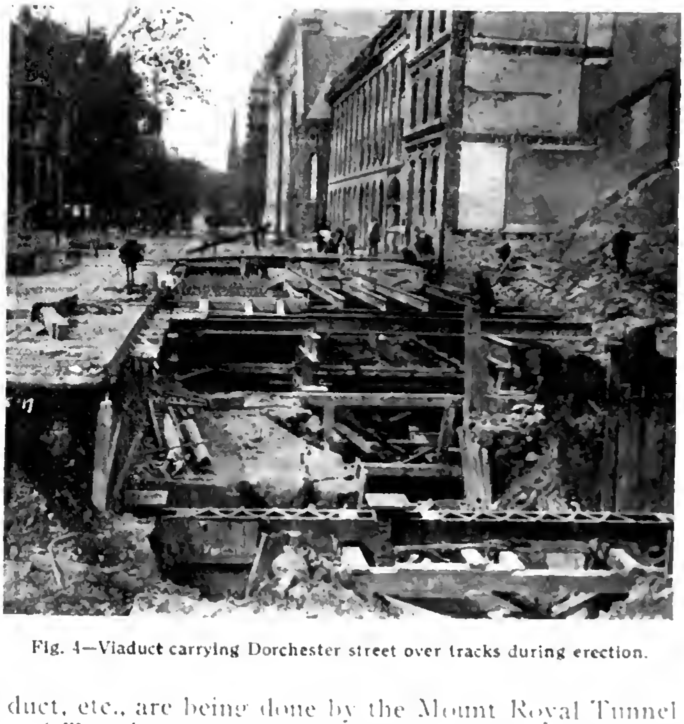


Fig. 4—Viaduct carrying Dorchester street over tracks during erection.

duct, etc., are being done by the Mount Royal Tunnel and Terminal Company, of which Mr. S. P. Brown is chief engineer, Mr. W. E. Joyce engineer of design, Mr. J. C. K. Stuart general superintendent, and Mr. W. C. Lancaster electrical engineer.

Which is the more important at the present juncture—food or roads? Will it be better to denude the roads of labor in order to have more on the farms, or to keep up our roads to a proper standard? Is not this one of the problems which the war has brought before us, and which will require a prompt solution?—The Surveyor.

Piling Difficulties in Waterway Work

At St. Charles River — Steel Sheet Piling Hard to Drive — Large Dam, Locks, Retaining Walls and Sluices Being Built Chiefly with Floating Plant

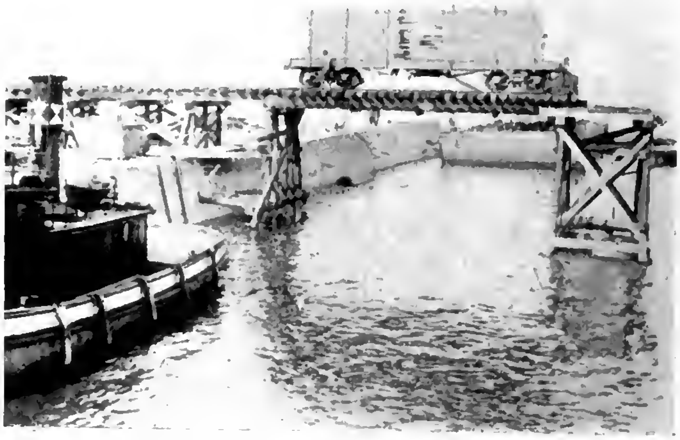
ONE of the most extensive waterway improvements in the Province of Quebec relates to the St. Charles River, and consists of the construction of a dam at the head of the Quebec harbor, locks, the building of retaining walls, sluices for controlling the water, etc. The contract is being carried out by Quinlan & Robertson, Ltd., Montreal, from plans prepared under the supervision of Mr. E. D. Lafleur, M.C.S.C.E., chief engineer of the Department of Public Works, Ottawa.

The chief difficulty is presented by the nature of the foundations—a fine sand, flowing easily under pressure, and going down to a depth of 100 feet. The object of the dam is to create a large basin at high-tide level. The plans provide for a dam 1,500 feet long, constructed of concrete, 30 feet high, with a 26-foot base and a 6-foot top. A row of steel sheet piling 30 feet long is to be built under the toe and a row 25 feet long under the heel, 22 feet between the rows, with a concrete apron 2 feet thick winding upstream for 150

Lock Caisson No. 1 at St. Charles river, showing pockets and recesses for gate valves.

feet from the centre of the dam. The water flow is taken care of through two sluiceway openings, each 53 feet wide, fitted with Stoney sluices and paved with concrete and stone for 600 feet downstream.

Two lift-locks, 65 feet by 450 feet, permit the passage of vessels of 22-foot draft. The lock area is enclosed by 40-foot steel piles, having the top of the piles 22 feet below low tide. The floor, 15 feet thick, is reinforced with steel bars top and bottom. The Canadian Northern line crosses at the head of the locks, and protection is given by driving steel piling 30 feet long around the piers and abutments and carrying the piers on wooden-bearing piles. The steel piling requires 3,900 tons of interlocking sheet piling, the majority being Lackawanna arch web and the other United States steel. The driving of the piles presented some difficulties, owing to the nature of the sand. Various types of steam hammers are being employed, and, while the 8,000-pound hammer gives the most efficient results, no form stands very long under the severe conditions. In some instances a pile will not penetrate an



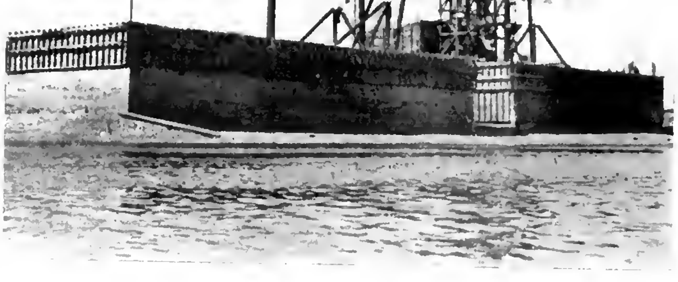
Looking down sluiceway, showing downstream wall and temporary stone loading trestle.

inch under 500 blows; in others they turn completely over on the top; while wooden piles will not penetrate more than 17 feet without breaking up.

Of the excavations—totalling 700,000 yards—half is completed. The total concrete in all the structures amounts to approximately 200,000 cubic yards.

In the main, a floating plant is employed. This includes a dipper dredge with 4½-yard dipper and a 12-inch suction dredge. The former is served by three dump scows of 350 yards capacity. The suction dredge, however, discharges off the side of the lock through pipe lines. The concrete plant is also of the floating description. This consists of two 1-yard mixers. Six scows, fitted with derricks, are employed in driving the steel and wooden piles, excavating, or clamming from the pockets of open concrete caissons, of which eleven are now sunk, three of them about 40 feet deep.

Besides the above three tugs and a number of flat



Lower guide pier caisson No. 1, 2 and 3 at extreme low tide.

scows and motor launches are employed, all the floating plant having been constructed by Quinlan & Robertson, Ltd. Broken stone is dumped by the Quebec Railway direct from the cars on to the scows, while the C.P.R. and Canadian Northern also discharge material direct from the cars on to the site of the work.

A large number of shops—machine, steel, carpenter, etc.—are built on the shore. The equipment also in-

Driving 40 ft. Lackawanna arched web steel sheet piling to grade 20 ft. below extreme low water with 8,000 lb. steam hammer.

cludes locomotives, travelling cranes, derricks, sidings, etc.

The engineers on the work are Messrs. E. A. Hoare, C.E., the resident engineer; R. Adams, and Z. Langlois. At the beginning of the work the contractors were represented by Mr. Alan Powell, C.E., and Mr. Robert Powell, and when these gentlemen left for overseas the contractors appointed Mr. E. A. Forward, C.E., and Mr. J. R. Russell. Mr. M. J. Butler, C.E., is the consulting engineer for Quinlan & Robertson, Ltd., and Mr. U. Marcotte superintendent of works.

Mechanical Filtration Plant Planned for Dorval, P. Q.

Dupont, Roy & Baudouin, Montreal, have prepared plans for a mechanical gravity filtration plant for the town of Dorval, P.Q. At present there is a plant for pumping water from the St. Lawrence and storing it in an elevated reservoir of 86,000 United States gallons capacity. It is now proposed to construct a filtration system which will have a capacity of 500 United States gallons per minute. The coagulation basin is rated at 80,000 United States gallons and the clear water basin at 100,000 gallons. The basins will be built of reinforced concrete. Two high lift pumps are at present in operation, and it has been decided to instal two low lift pumps. One will be a centrifugal pump, direct connected to an electric motor, and the other, to be used as an auxiliary, a steam plunger pump. Living quarters for the engineer, of brick, will be constructed above the filtration plant.

The Beaver Creek Timber Company, Ltd., has been incorporated, with a capital of $100,000, head office at Vancouver.

Rebuilt Theatre at Toronto

Nearing Completion—Details of Design and Architecture—Columns Eliminated in Auditorium

THE rebuilding of the Princess Theatre, Toronto, which was destroyed by fire some time ago, is now nearing completion. The new structure is being erected on the site of the old theatre on King Street West. It will be fitted out in the most modern style, and in interior arrangements and equipment will be such as to make it a most comfortable and up-to-date playhouse. Owing to difficulties in the delivery of steel, the work has been delayed and inconvenienced, but it is expected that the building will be finished by August of this year.

In front the building is contiguous with the adjoining structures, but the main portion is surrounded by an open court. The entrance rotunda is 72 feet wide, and contains the box office, ladies' retiring room, and smoking room, on either side of the lobby. This lobby is perhaps of unusual width—28 feet. It is floored with cork tile, and the walls and dados are of marble. The smoking and retiring-rooms are similarly finished in harble, with floors of terrazzo. The facade is faced with yellow tapestry brick and has a wrought iron marquise.

The auditorium proper is 100 feet long and 81 feet 6 inches in width, and contains one balcony 70 feet in depth. There are also ten boxes. The total seating capacity is close to 1,700. The interior trimming will be of mahogany and the flooring of pine, while the ceiling will be ornamental plaster. The proscenium arch opening is 40 feet 4 inches in width and 27 feet 10 inches high, and the stage floor extends back 35 feet 6 inches.

From the foyer two flights of stairs lead to the mezzanine floor, and from there to the upper section of the balcony. Access from the mezzanine to the lower section of the balcony is provided by two ramps, one on each side. The stairs will be finished in white marble, with ornamental iron railings. The mezzanine will also be finished in marble, with pine flooring, and will have a dummy fireplace and a suspended ceiling.

Liberal Provision for Egress

In addition to the main entrance there are ten exits. On the main floor there are three on each side of the building, which will be used regularly and not merely for emergency purposes. From the balcony there are two exits on each side, opening onto steel fire-escapes. All exits have fireproof doors, and lead to an open court which extends all around the main part of the building and provides access to the street.

The building is erected on concrete foundations, and is completely fireproof, the main portion being of the structural steel and Denison tile type of construction, while the entrance rotunda and the section containing the stage is of solid masonry. All floors are of concrete construction. In the entrance rotunda a hollow slab type of floor has been laid, with two inches of concrete over hollow tile (see Contract Record, Sept. 20, 1916, p. 915). The tiles, 12 inches in length, are spaced at 16-inch centres, leaving a 4-inch joist. In the auditorium the floor is of solid reinforced concrete, 6½ inches thick. The stage floor is of solid reinforced concrete construction, except for a removable wood portion in the centre, this latter provision being necessary for certain stage productions. The building is also roofed with reinforced concrete, and the steel columns are fireproofed with the same material.

Columns Eliminated in Auditorium

The main support of the balcony is a large steel girder, 84 feet in length and weighing 25 tons, to which the load is transferred by steel beams. Beyond this point a further support is provided for the balcony by means of a smaller girder and two transverse girders, by which the former is carried. The transverse girders, in turn, are each supported at one end by the main girder and at the other by one of the steel columns. The necessity for supporting columns beneath the balcony is thus eliminated, and there is an excellent view of the stage from every part of the auditorium.

The operator's booth is located outside of the auditorium, being cantilevered from the main roof purlins, which are extended back from the rear wall. It is thus suspended over the flat roof of the front section of the building, with which it is connected by a flight of iron steps. It is absolutely fireproof, having walls of tile and wire-glass window with metal frame.

The building is heated by the indirect system, fresh air being washed and brought in over steam-heated coils. Forced ventilation is provided by two Swartout ventilators on the roof, which draw the fresh air into the building.

The building was designed by Mr. C. Howard Crane, of Detroit,, and Mr. C. J. Read, of Toronto, is the supervising architect. The Frank Farrington Company, of Detroit, are the general contractors, their construction superintendent being Mr. Everham.

Suppliers of Material

Sub-contracts for the work were let as follows: Hunter Structural Steel Company, steel work and fire-escapes; Canadian Ornamental Iron Company, ornamental iron work; Canada Glass Company, marble work; Douglas Brothers, fireproof doors; Italian Mosaic Marble Company, terrazzo and tile work; W. J. McGuire, Ltd., heating and plumbing; E. J. Curry, plain plaster and ornamental plaster work; W. Halliday, interior woodwork; Don Valley Brick Company, tapestry brick; Sun Brick Company, Denison tile; Canada Cement Company, cement; Trussed Concrete Steel Company, reinforcing steel.

Useful Life of Units in Waterworks Plants

Report Summarizes in a General Way the Estimated Probable Durabilities of Various Items of Equipment

A COMMITTEE of the American Waterworks Association recently prepared a report on "Depreciation," which includes a quantity of useful data on waterworks units. The following general conclusions are taken from this report:

Storage Reservoirs and Heavy Earthen or Masonry Dams—Large Masonry Conduits and Tunnels.—All structures of earth or earth and masonry are very durable, and in some cases reservoirs, aqueducts, and dams have lasted thousands of years. Undoubtedly such construction, well maintained, is ordinarily good for some hundreds of years, physically often far outliving their functional usefulness.

Functional.—All structures holding or conveying water are subject to accident from rupture, floods, burrowing animals, ice pressure, windstorms, leaks, insecure foundation, polluting influences, and malicious destruction.

Physical and contingent losses of value will be made good ordinarily by operating maintenance. This being thoroughly done, such structures should, in addition, be amortized about as follows:

Large storage reservoirs, well located	75-150
Heavy earthen or masonry dams	75-150
Large masonry conduits and tunnels	75-150

Conduits and Distribution Pipe of Cast Iron of Large Diameter.—Cast iron pipe coated and buried in the ground is a very durable structure. We have little knowledge of its final effective life from a physical point of view. There are some instances of 200 years' life for uncoated pipe. Largely, we must amortise such durable material, kept clean and well maintained, again by consideration of the possible changes in public need, functional usefulness, and the burden of a reasonable amortisation, say, 75-125.

Conduits and Distribution Pipe of Wrought Iron or Steel of Large Diameter.—Thickness of shell and sensitiveness to a greater range of deteriorating influences must of necessity bring the life of wrought iron and steel physically below that of cast iron, and in many cases below functional considerations, 35-75.

Conduits and Distribution Pipe of Wood Stave of Large Diameter.—Ultimate experience somewhat limited, but thought to be about in same class as steel, when well protected and constantly saturated, 30-60.

Distribution Pipe of Small Diameter. — (a) Cast Iron: Limitations of size increase difficulties in interior cleaning and maintenance. Such smaller mains are at times removed in rapidly-growing cities to make way for larger pipe. Often they are only supplemented, 30-70.

It should be noted that in slow-growing and smaller cities small mains are less liable to be outgrown than in larger cities, 50-90.

(b) Wrought Iron and Steel Mains: Affected by kind of water carried, soil, and coating. Liability of replacement probably greatest influence in shortening useful life, 25-40.

(c) Services:	Wrought iron and steel	15-30
	Lead	40-60

Of services, it should be noted that character of water carried, soil, and coating are influential, but changing needs are also important.

Small Distribution Reservoirs.—Physically, these structures are very permanent. Changing needs often destroy or impair their usefulness and value; they are often surrounded by growing population and increasing land value, which, in connection with decreasing need, make it desirable to abandon them. They sometimes lose value on account of need for increased head, 50-75.

Standpipes.—Are affected by most of the influences mentioned above, and lose value in rapidly growing towns by insufficient proportional storage capacity with increased consumption. They often have value as regulators, however, long after their storage usefulness is diminished:

Wrought iron and steel	30-60
Reinforced concrete	50-60

Valves.—Valves physically should be amortised on the basis of the life of the valve body, the working parts being subject to operating maintenance. Fundamentally, they are more subject to change and improvement than the pipe in which they are set, and therefore should have shorter life, 40-60.

Hydrants.—Theoretically should have the average physical life of the hydrant body, the same as valves, but being in part exposed and more liable to accident and injury, and more often operated, may be considered to have somewhat shorter life than valves, 30-50.

Meters.—Physically they should be amortised on the basis of the life of the meter casing, the working parts being subject to renewal and repair, chargeable to operating maintenance. Fundamentally, being of delicate construction and of necessity exposed to frost, clogging, and other adverse influences and often renewed, suggested life, 20-30.

Pumping Machinery.—Pumping machine units are functionally sensitive to changes in consumption, growth of population, improvements in the art, influences affecting sources of supply, amount of use, character of water, etc., and these are the conditions that ordinarily fix their useful life.

Where function does not control physical life for amortisation purposes it should be predicated on the probable useful life of the stationary and heavier castings, all working parts being cared for annually by operating maintenance:

High duty, large units	35-60
High duty, small units (say, below 6 m.g.d. cap.)	25-50
Ordinary direct acting	20-40
Centrifugal, not geared	20-30
Centrifugal, geared	15-25

Boiler feed and auxiliary pumps usually take the life of the units to which they are attached.

Steam Engines.—About the same considerations as above, 20-40.

Boilers.—Are affected by water used, care and attention, changes in station, and changes in pressure. They may often have a long period of usefulness in reserve, 15-30.

Electric Generators and Motors.—In general, follow the reasoning on pumps, but are shorter lived, 20-30.

Filter Plants.—Now well standardized. Life should be predicated on general usefulness of station and source, as well as function of the filters themselves:

Masonry filters	30-50
Wood filters	15-30

Buildings.—Must be reviewed in the light of the probable life of the station as a whole. In rapidly-growing towns they are frequently outgrown, but can often be enlarged. They lose value often in a general way because of changes in the style of architecture. Where function does not control their lives physically it should be based on masonry walls, foundations, and roof supports, all other parts being removed from time to time by operating maintenance account:

Masonry	30-60
Wood	20-40

Stacks.—Are limited in life to conditions of power production directly; somewhat affected by style and general appearance:

Masonry	25-50
Steel	10-25

Tree Surgery in France

"Tree surgery" is an art which has been better developed in France than in this country, and it is fortunate that so much attention has been paid to it. For, as a consequence, thousands of fruit and other trees are now flourishing which the Germans, in their lust for destruction, essayed to destroy, with that malignity characteristic of their race, in their retreat before the French armies. When the close pursuit of the French armies gave the Germans insufficient time in which to completely cut down the trees, the vandals cut off a circle of bark around the trunk, well knowing that a few days' exposure to the sun would be sufficient to kill peach, plum, apple, apricot, and cherry trees that had been half a century in attaining their productiveness. Fortunately, French arboriculturists were summoned into counsel to face the problem as to how to preserve the trees so mutilated. They were, happily, equal to the task, and proceeded to bind up the wounds like the wounds of a soldier, and thousands of army surgeons and Red Cross ambulance drivers and stretcher-bearers assisted in the work. The circle where the bark had been cut away was first covered with a grafting cement and the entire wound bandaged—often with bandages that had been prepared for human limbs. So great was the number of trees that had to be dressed in this way that the entire available supply of grafting preparation was quickly exhausted. Where the trees had been completely cut or sawn down the protruding stumps were trimmed, and the exudation of the sap was prevented by clay or cement dressings, while branches from the upper portion of the trees which showed signs of life activity were grafted on many of the severed stumps. To-day, we learn, these grafts are in full leaf and blossom. The roots appear to have been entirely saved by this process, and years have been saved in restoring the cut-down orchards of France. "Tree surgery" is no new art, and for several years, particularly in America, the practice of preserving trees that have been injured by disease or accident has been successfully carried out by filling stumps with cement. Tht protection of several vegetable tissues with wax, tar, and other substances has been long used in horticulture and arboriculture. The principles governing the "surgery" of plants are, in many respects, similar to those which appertain to human surgery.—Municipal Engineering.

Lectures on Concrete Practice

The Department of Industrial Education, University of Chicago, and the Extension Division of the Portland Cement Association are co-operating in providing a summer course in concrete, which offers a series of lectures by engineers and teachers thoroughly familiar with the cement industry and the subject of concrete as taught in manual training and vocational courses. The aim of the course is to provide practical and complete information for those who wish to learn the theory and fundamentals of concreting. The lectures—twelve in all—afford instruction in the various phases of concreting practice and provide demonstrations of the proper methods.

Costs of Bridge in Steel and Concrete Compared

ONE of the developments of present-day conditions in the building trade is the narrowing of the margin in cost which formerly existed between steel and concrete construction. This is due, in large measure, to the greatly increased cost of steel, and, therefore, may be merely temporary. For the duration of the war, however, there seems little chance but that the present trend in favor of concrete will continue. A special example which illustrates the point is described in the Engineering News-Record, where the tender on a concrete bridge is actually less than the tender for the same bridge constructed of steel. The actual figures are given in the following extracts; also details of the bridge in the accompanying illustration:

Cost for Concrete Arch Viaduct Less Than for Steel Design

Of particular interest in illustrating the comparative costs, at present-day prices, of concrete and of steel bridges of the viaduct type is the bridge now being constructed over the James River at Richmond, Va. Owing to the low cost of the concrete aggregates, furnished by the railroad, the bid for a concrete arch viaduct 2,278 feet long was nearly $15,000 less than for an alternate steel design of plate girders and steel towers on concrete pedestals. The new structure is designed for the equivalent of Cooper's E-60 loading.

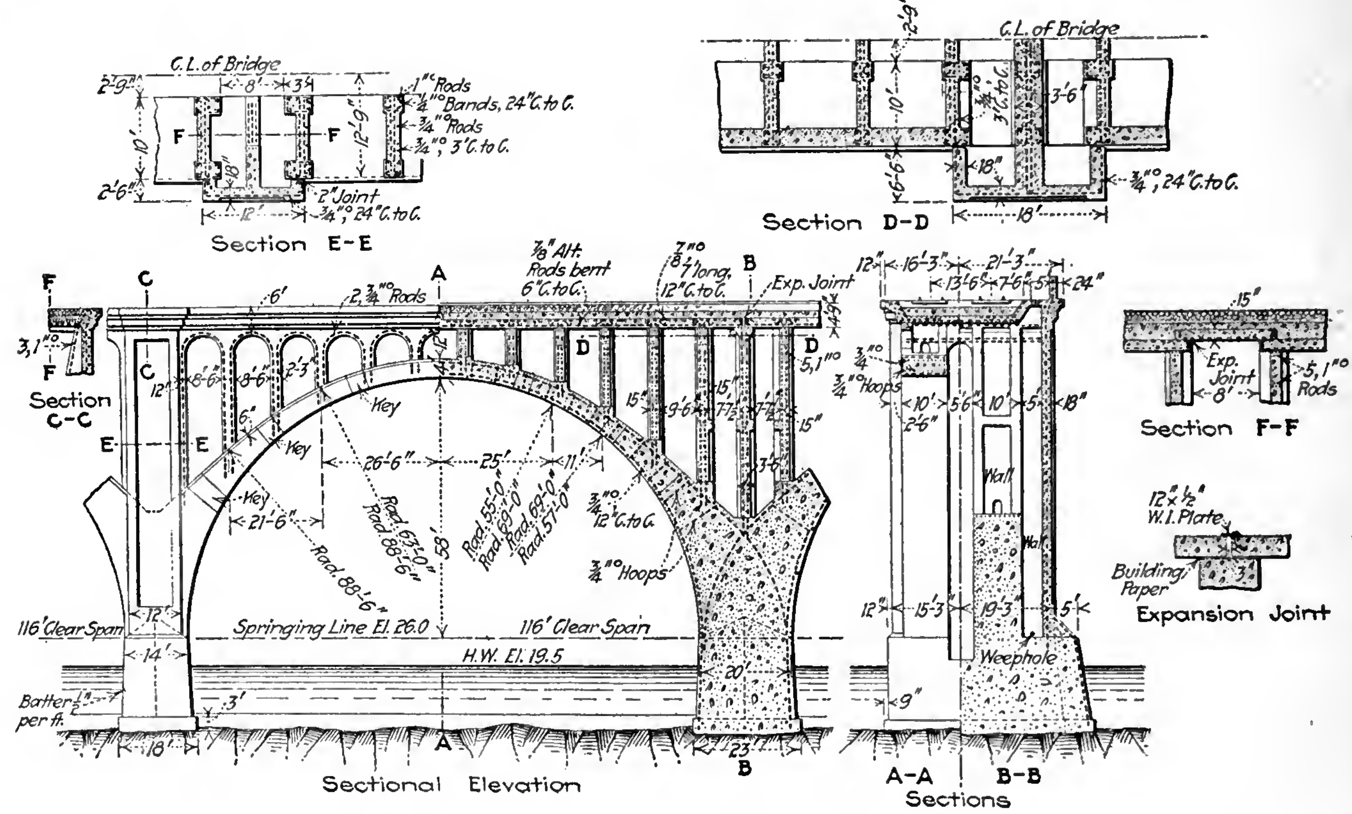
Alternative Designs Furnished

The river bed is of granite, and a solid foundation is secured with comparatively little excavation. The maximum river stage is 11 feet above mean water, while at times a large part of the river bed is exposed. This location seemed well suited to concrete arch construction, but alternative designs were made by the consulting engineers for a concrete arch bridge and also for a steel viaduct with plate-girder spans, supported on steel towers resting on concrete piers.

Bids were received for both designs, and a comparison of the lowest tenders is as follows:

Concrete Arch		Steel Viaduct	
Bid to subgrade ...	$416,122	Bid to subgrade	$444,885
Ballast and ties	5,520	Track	7,950
Rails	6,532	Approaches	49,600
Approaches	49,600		
	$477,774		$492,435

These prices are based upon a very low cost for aggregates, as the railroad company agreed to furnish sand and gravel for concrete at 60 cents per cubic yard.



Details of typical 116 ft. arch for which a comparison of costs is made.

Costs Compared

The prevailing commercial prices per cubic yard of these aggregates at Richmond were $1.05 for sand and $1.20 for gravel. The concrete arch bridge contains 41,400 cubic yards of concrete and the steel structure 3,350 cubic yards. In order to make a comparison of figures that could have been expected had the contractors furnished sand and gravel at market prices, there should be added to the above totals $30,900 for the concrete arch design and $2,530 for the steel design, thus making the comparison as follows: Concrete arch, $508,674; steel viaduct, $494,965.

This in general may be taken as a fair comparison of the relative costs of the highest types of design, as exemplified in a concrete bridge with its beautiful lines and the advantages of ballasted track, low maintenance, and long life, as against a plain and less satisfactory design in steel with open floor, higher maintenance, and shorter life. The contract was awarded for the concrete arch bridge, which is now under construction.

General Dimensions of Arch Design

The concrete design provides for a bridge 32 feet 6 inches wide and 2,278 feet long, including abutments. The base of rail is at elevation 100 above the river level, which is taken as datum. There are twelve arches of 116 feet clear span and 58 feet rise, three arches of 122 feet clear span and 58 feet rise, three arches of 60 feet clear span and 30 feet rise, and 70 feet of abutment approaches. The main span piers are 14 feet thick at springings, with an abutment pier 20 feet thick for each group of three arches. The abutment and the 60-feet arches have solid earth-filled spandrels, while the main arches are of open spandrel design, with slab-floor system. The main arches spring from elevation 21, and are full-centered.

Concealed expansion joints are provided for the structure above the arches at each pier throughout the bridge. No hand-rail is used, but refuge bays 5 feet wide are provided over each abutment pier on both sides of the bridge. The upper part of each pier has a pediment which, together with the refuge bay treatment, breaks the straight line of the coping, giving a pleasing artistic effect.

All surfaces of the concrete are reinforced to prevent face cracking, and the reinforcement of the whole structure is in accordance with the standard specifications of the engineers, allowing 16,000 pounds per square inch tension in steel and 650 pounds per square inch maximum compression in the concrete. Exposed surfaces are given a spade finish, secured by using dressed lumber forms and spading the concrete during placing, to secure a dense mixture of mortar near the form surface. All arches and walls are provided with drainage, and are waterproofed on the inside with a bituminous membrane.

Constitution, Mixing and Placing of Concrete

as Recommended by the Joint Committee on Concrete — Continued from Last Issue

Materials

The quality of all the materials is of paramount importance. The cement and also the aggregates should be subject to definite requirements and tests.

1. Cement

There are available for construction purposes, Portland, Natural and Puzzolan or Slag cements.

(a) Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

It has a definite chemical composition varying within comparatively narrow limits.

Portland cement only should be used in reinforced concrete construction or in any construction that will be subject to shocks, vibrations, or stresses other than direct compression.

(b) Natural cement is the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas.

Although the limestone must have a certain composition, this composition may vary within much wider limits than in the case of portland cement. Natural cement does not develop its strength as quickly nor is it as uniform in composition as portland cement.

Natural cement may be used in massive masonry where weight rather than strength is the essential feature.

Where economy is the governing factor a comparison may be made between the use of natural cement and a leaner mixture of portland cement that will develop the same strength.

(c) Puzzolan or slag cement is the product resulting from finely pulverizing a mechanical mixture of granulated basic blast-furnace slag and hydrated lime.

Puzzolan cement is not nearly as strong, uniform, or reliable as portland or natural cement, is not used extensively, and never in important work; it should be used only for unimportant foundation work underground where it is not exposed to air or running water.

(d) Specifications.—The cement should meet the requirements of the specifications and methods of tests for portland cement, which are the result of the joint labors of special committees of the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, and other affiliated organizations, and the United States Government.

2. Aggregates

Extreme care should be exercised in selecting the aggregates for mortar and concrete, and careful tests made of the materials for the purpose of determining the quality and grading necessary to secure maximum density or a minimum percentage of voids. Bank gravel should be separated by screening into fine and coarse aggregates and then used in the proportions to be determined by density tests.

(a) Fine aggregate should consist of sand, or the screenings of gravel or crushed stone, graded from fine to coarse, and passing when dry a screen having ¼-in. diameter holes, it preferably should be of siliceous material, and not more than 30 per cent. by weight, should pass a sieve having 50 meshes per linear inch; it should be clean, and free from soft particles, lumps of clay, vegetable loam or other organic matter.

Fine aggregate should always be tested for strength. It should be of such quality that mortar composed of one part portland cement and three parts fine aggregate by weight when made into briquettes, prisms or cylinders will show a tensile or compressive strength, at an age of not less than 7 days, at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand. If the aggregate be of poorer quality, the proportion of cement should be increased to secure the desired strength. If the strength developed by the aggregate in the 1:3 mortar is less than 70 per cent. of the strength of the Ottawa-sand mortar, the material should be rejected. In testing aggregates care should be exercised to avoid the removal of any coating on the grains, which may affect the strength; bank sands should not be dried before being made into mortar, but should contain natural moisture. The percentage of moisture may be determined upon a separate sample for correcting weight. From 10 to 40 per cent. more water may be required in mixing bank or artificial sands than for standard Ottawa sand to produce the same consistency.

(b) Coarse aggregate should consist of gravel or crushed stone which is retained on a screen having ¼-in. diameter holes, and should be graded from the smallest to the largest particles; it should be clean, hard, durable, and free from all deleterious matter. Aggregates containing dust and soft, flat or elongated particles, should be excluded. The Committee does not feel warranted in recommending the use of blast furnace slag as an aggregate, in the absense of adequate data as to its value, especially in reinforced concrete construction. No satisfactory specifications or methods of inspection have been developed that will control its uniformity and ensure the durability of the concrete in which it is used.

The aggregate must be small enough to produce with the mortar a homogeneous concrete of sluggish consistency which will pass readily between and easily surround the reinforcement and fill all parts of the forms. The maximum size of particles is variously determined for different types of construction from that which will pass a ½-in. ring to that which will pass a 1½-in. ring.

For concrete in large masses the size of the coarse aggregate may be increased, as a large aggregate produces a stronger concrete than a fine one; however, it should be noted that the danger of separation from the mortar becomes greater as the size of the coarse aggregate increases.

Cinder concrete should not be used for reinforced concrete structures except in floor slabs not exceeding 8-ft. span. It also may be used for fire protection purposes where not required to carry loads. The cinders used should be composed of hard, clean, vitreous clinker, free from sulphides, unburned coal or ashes.

3. Water

The water used in mixing concrete should be free from oil, acid, alkali, or organic matter.

4. Metal Reinforcement

The Committee recommends as a suitable material for reinforcement, steel of structural grade filling the requirements of the Specifications for Billet-Steel Concrete Reinforcement Bars of the American Society for Testing Materials.

For reinforcing slabs, small beams or minor details, or for reinforcing for shrinkage and temperature stresses, steel wire, expanded metal, or other reticulated steel may be used, with the unit stresses hereinafter recommended.

The reinforcement should be free from flaking rust, scale or coatings of any character which would tend to reduce or destroy the bond.

MIXING AND PLACING

1. Proportions

The materials should be carefully selected, of uniform quality, and proportioned with a view to securing as nearly as possible a maximum density, which is obtained by grading the aggregates so that the smaller particles fill the spaces between the larger, thus reducing the voids in the aggregate to the minimum.

(a) Unit of Measure.—The measurement of the fine and coarse aggregates should be by loose volume. The unit of measure should be a bag of cement, containing 94-pound net, which should be considered the equivalent of one cubic foot.

(b) Relation of Fine and Coarse Aggregates.—The fine and coarse aggregates should be used in such proportions as will secure maximum density. These proportions should be carefully determined by density experiments, and the grading of the fine and coarse aggregates should be uniformly maintained, or the proportions changed to meet the varying sizes.

(c) Relation of Cement and Aggregates.—For reinforced concrete construction, one part of cement to a total of six parts of fine and coarse aggregates measured separately should generally be used. For columns richer mixtures are preferable. In massive masonry or rubble concrete a mixture of 1:9, or even 1:12, may be used.

These proportions should be determined by the strength or other qualities required in the construction at the critical period of use. Experience and judgment based on observation and tests of similar conditions in similar localities are excellent guides as to the proper proportions for any particular case.

In important construction advance tests should be made on concrete composed of the materials to be used in the work. These tests should be made by standardized methods to obtain uniformity in mixing, proportioning, and storage, and in case the results do not conform to the requirements of the work, aggregates of a better quality or more cement should be used to obtain the desired quality of concrete.

2. Mixing

The mixing of concrete should be thorough, and continue until the mass is uniform in color and homogeneous. As the maximum density and greatest strength of a given mixture depend largely on thorough and complete mixing, it is essential that this part of the work should receive special attention and care.

Inasmuch as it is difficult to determine, by visual inspection, whether the concrete is uniformily mixed, especially where aggregates having the color of cement are used, it is essential that the mixing should occupy a definite period of time. The minimum time will depend on whether the mixing is done by machine or hand.

(a) Measuring Ingredients.—Methods of measurement of the various ingredients should be used which will secure at all times separate and uniform measurements of cement, fine aggregate, coarse aggregate, and water.

(b) Machine Mixing.—The mixing should be done in a batch machine mixer of a type which will ensure the uniform distribution of the materials throughout the mass, and should continue for the minimum time of 1½ minutes after all the ingredients are assembled in the mixer. For mixers of two or more cubic yards capacity the minimum time of mixing should be two minutes. Since the strength of the concrete is dependent upon thorough mixing, a longer time than this minimum is preferable. It is desirable to have the mixer equipped with an attachment for automatically locking the discharging device so as to prevent the emptying of the mixer until all the materials have been mixed together for the minimum time required after they are assembled in the mixer. Means should be provided to prevent aggregates being added after the mixing has commenced. The mixer should also be equipped with water storage, and an automatic measuring device which can be locked is desirable. It is also desirable to equip the mixer with a device recording the revolutions of the drum. The number of revolutions should be so regulated as to give at the periphery of the drum a uniform speed; about 200 feet per minute seems to be the best speed in the present state of the art.

(c) Hand Mixing.—Hand mixing should be done on a watertight platform, and especial precautions taken after the water has been added to turn all the ingredients together at least six times, and until the mass is homogeneous in appearance and color.

(d) Consistency.—The materials should be mixed wet enough to produce a concrete of such a consistency as will flow sluggishly into the forms and about the metal reinforcement when used, and which, at the same time, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. The quantity of water is of the greatest importance in securing concrete of maximum strength and density; too much water is as objectionable as too little.

(e) Retempering.—The remixing of mortar or concrete that has partly set should not be permitted.

3. Placing Concrete

(a) Methods.—Concrete, after the completion of the mixing, should be conveyed rapidly to the place of final deposit; under no circumstances should concrete be used that has partly set.

Concrete should be deposited in such a manner as will permit the most thorough compacting, such as can be obtained by working with a straight shovel or slicing tool kept moving up and down until all the ingredients are in their proper place. Special care should be exercised to prevent the formation of laitance; where laitance has formed it should be removed, since it lacks strength and prevents a proper bond in the concrete.

Before depositing concrete the reinforcement should be carefully placed in accordance with the plans. It is essential that adequate means be provided to hold it in its proper position until the concrete has been deposited and compacted; care should be taken that the forms are substantial and thoroughly wetted (except in freezing weather) or oiled, and that the space to be occupied by the concrete is free from debris. When the placing of concrete is suspended all necessary grooves for joining future work should be made before the concrete has set.

When work is resumed, concrete previously placed should be roughened, cleansed of foreign material and laitance, thoroughly wetted, and then slushed with a mortar consisting of one part Portland cement and not more than two parts fine aggregate.

The surfaces of concrete exposed to premature drying should be kept covered and wet for a period of at least seven days.

Spouting Satisfactory When Continuous

Where concrete is conveyed by spouting, the plant should be of such a size and design as to ensure a practically continuous stream in the spout. The angle of the spout with the horizontal should be such as to allow the concrete to flow without a separation of the ingredients; in general an angle of about 27 degrees, or one vertical to two horizontal, is good practice. The spout should be thoroughly flushed with water before and after each run. The delivery from the spout should be as close as possible to the point of deposit. Where the discharge must be intermittent a hopper should be provided at the bottom. Spouting through a vertical pipe is satisfactory when the flow is continuous; when it is unchecked and discontinuous it is highly objectionable, unless the flow is checked by baffle-plates.

(b) Freezing Weather.—Concrete should not be mixed or deposited at a freezing temperature, unless special precautions are taken to prevent the use of materials covered with ice crystals or containing frost, and to prevent the concrete from freezing before it has set and sufficiently hardened.

As the coarse aggregate forms the greater portion of the concrete, it is particularly important that this material be warmed to well above the freezing point.

The enclosing of a structure and the warming of the space inside the enclosure is recommended, but the use of salt to lower the freezing point is not recommended.

(c) Rubble Concrete.—Where the concrete is to be deposited in massive work its value may be improved and its cost materially reduced by the use of clean stones, saturated with water, thoroughly embedded in and entirely surrounded by concrete.

(d) Under Water.—In placing concrete under water it is essential to maintain still water at the place of deposit. With careful inspection the use of tremies, properly designed and operated, is a satisfactory method of placing concrete through water. The concrete should be mixed very wet (more so than is ordinarily permissible) so that it will flow readily through the tremie and into place with practically a level surface.

Tremie Suitable for Under-water Work

The coarse aggregate should be smaller than ordinarily used, and never more than 1 in. in diameter. The use of gravel facilitates mixing and assists the flow. The mouth of the tremie should be buried in the concrete so that it is at all times entirely sealed and the surrounding water prevented from forcing itself into the tremie; the concrete will then discharge without coming in contact with the water. The tremie should be suspended so that it can be lowered quickly when it is necessary either to choke off or prevent too rapid flow; the lateral flow preferably should be not over 15 feet.

The flow should be continuous, in order to produce a monolithic mass and to prevent the formation of laitance in the interior.

In case the flow is interrupted it is important that all laitance be removed before proceeding with the work.

In large structures it may be necessary to divide the mass of concrete into several small compartments or units, to permit the continuous filling of each one. With proper care it is possible in this manner to obtain as good results under water as in the air.

A less desirable method is the use of the drop bottom bucket. Where this method is used the bottom of the bucket should be released when in contact with the surface of the place of deposit.

The wide circle of friends of Mr. J. A. Jamieson, consulting engineer, of Montreal, will hear with pleasure that he has now nearly recovered from the severe injuries received as the result of being hit by a tramway car. Mr. Jamieson is now able to resume his professional duties, although he has not yet recovered the full use of his legs.

How Alkali Affects Concrete

INVESTIGATIONS covering a considerable period have been carried out by the United States Reclamation Service, Drainage Division of the Department of Agriculture, and the Portland Cement Association of the United States, on the effect of alkali on concrete, and the results have been made public in technologic paper 95 of the Bureau of Standards. The investigation comprised the manufacture of some 9,000 cement drain tiles of twenty different varieties and many concrete blocks. These were shipped to various parts of the country and installed in operating drains and areas where alkali is greatly concentrated and where concrete failures had been reported.

Included in these varieties of tile were mixtures ranging from one part cement to one and one-half parts sand to one cement to four parts sand, both machine and hand-made, and cured in steam and by sprinkling with water. Practically all types and mixtures commonly used in the humid region are represented, as well as others of greater wall thickness and wetter consistencies than can be made by most commercial tile machines. No special compounds or treatments have been used up to this time, except that one series each of tile were dipped in cement grout and another in hot tar, while ferrous sulphate was added to the mixing water of a third.

Concrete block or short columns were molded at Denver, using the proportions of 1:1½:3 and 1:2½:5, and a complete set of block were sent to eight projects of the Reclamation Service for installation in the most highly alkaline waters available on each. In addition, similar block were molded on each project, using local materials, which were installed with the Denver block.

Crushing tests of the drain tile have been made yearly for the last three years, using a portable tile-testing machine which can be set up at the site of the drain. The concrete block are inspected yearly, and signs of disintegration are carefully noted. Where disintegration has occurred additional block have been molded after special treatment of the aggregates.

Samples of alkalies, soils, and drainage waters have been collected and analyzed at intervals.

While complete conclusions, as to the durability of concrete drain tile and concrete in alkali soils similar to those included in this investigation, cannot yet be drawn, the results of tests and observations to date may be summed up as follows:

Concrete

Concrete which is to be placed in alkali soils should be made of selected and tested materials so proportioned as to produce a dense concrete. As small an amount of mixing water should be used as will allow the mass to be properly placed. Unless these precautions are taken the resistance of the concrete to alkali action will be reduced.

Drain Tile

The following conclusions may be drawn for the use of concrete drain tile exposed to soils or waters containing alkali salts in quantities of 0.1 per cent. or more:

1. The use of concrete tile in soils containing alkali salts in large quantities is experimental.

2. Porous tile due to the use of lean mixtures or relatively dry consistencies are subject to disintegration.

3. Some dense tile are, under certain conditions, subject to surface disintegration.

4. Disintegration is manifested by physical disruption, caused by the expansion resulting from the crystallization of salts in the pores and by softening, resulting from chemical action of the solutions with the constituents of the cement.

5. While results obtained will not permit of a definite statement as to the relative effect of the various constituents of the salts, indications are that the greater the quantity of sulphate and magnesium present and the greater the total concentration of salts, the greater will be the disintegrating effect.

6. Tile made by the process commonly used, which allows the removal of forms immediately after casting, are subject to disintegration where exposed to soils or waters containing one-tenth per cent. or more alkali salts similar in composition to those encountered in this investigation.

7. The hand-tamped tile of plastic consistency, as made in this investigation, are not equal in quality to machine-made tile of the same mixture, and they do not resist alkali action as well.

8. Steam-cured tile show no greater resistance to alkali action than tile which are cured by systematic sprinkling with water.

9. Tile made of sand-cement have less resistance to alkali action than tile made of Portland cement of the same proportions.

10. The tar coating as used is not effective in preventing the absorption of alkali salts from the soil.

11. The cement grout coating is not effective in preventing the absorption of alkali salts from the soil.

12. No advantage is found in introducing ferrous sulphate into the concrete mixture.

If concrete drain tile are to be used in alkali soils or water containing 0.1 per cent. or more of salts, similar in composition to those encountered in this investigation, they should be made of good quality aggregate in proportions of not less than one part Portland cement to three parts aggregate. The consistency should preferably be quaking, which has proved the most resistant of all mixtures used. This is wetter than that generally used in commercial tile plants, and will probably require the retention of the tile in the molds for several hours, unless some means are found to hasten the hardening of the cement.

Apparatus for Gauging Pavements

An apparatus for gauging the subgrades, foundations, or wearing surfaces of pavements consists essentially of a template which is supported on the curbs and can be moved along the pavement by means of cables wound on the propelling mechanism at the centre. The template is in two pieces, each extending over half the pavement, and is furnished in any length desired. The lower edge, which is cut to fit the contour of the pavement, is shod with steel and is braced by steel rods at the sides to insure rigidity. Extension plates are provided at the ends for adjusting the machine to varying pavement widths. These permit an extension of two feet at each end, or a total of four feet, without changing templates. When a greater range is required extra templates are used.

At the end of the extension plate at each end is a frame carrying two small wheels, on which the gauge rolls along the curb. There is also a hand-wheel adjustment, by which the gauge can be raised any desired distance up to 18 inches. There is also a centre adjustment for varying the crown, and a lever at the centre, by which the whole gauge can be lifted up from the pavement. By means of this the gauge can be lifted ¼, ⅜, ½, ¾, or 1 inch above the grade for which it is set, the lever being automatically locked at each position.

The propelling mechanism consists of chain-driven drums operated by a crank, on which are wound cables running to the ends of the gauge and thence to anchorages in front of and behind the machine. There are two gears, one capable of moving the gauge along the street at a rate of 6 feet per minute and the other at 21 feet per minute.

An attachment for troweling concrete is also provided with the gauge. This is operated by a small gear driven from the propelling crank, and can be thrown out of gear and drawn up out of the way when not in use.

Among the advantages claimed for the machine are that it saves labor, insures accurate work, avoids the use of unnecessary material, and does work superior to that done by hand. It is known as the Roughen adjustable paving gauge, and is manufactured by the Roughen Adjustable Paving Gauge Company, of Fond du Lac, Wis.

The Raymond Concrete Pile Company, Ltd., have been awarded the contract for about 4,000 wooden piles for the Quebec Elevator foundations by the George A. Fuller Company, Ltd., general contractors.

Recommendations Regarding the Care and Treatment of Returned Soldiers

A special committee of the House of Commons—Sir Herbert Ames, chairman—has made its second report to the House on the care and treatment of returned soldiers. The report deals with (1) the medical care and the work of the Military Hospitals Commission; (2) the vocational training and re-education; (3) provincial co-operation in securing employment; (4) pay and allowance. With (2) and (3) we are all more particularly interested, as they indicate to what extent the government is holding itself responsible to re-establish our returned soldiers in civil life in the most useful capacity, and also to what extent the provincial governments are co-operating in securing these men employment. That part of the report which deals with these two sub-heads is, therefore, reproduced herewith:

Vocational Training and Re-education Under the Military Hospitals Commission

The matter of vocational training and the re-education of returned soldiers has been taken up with great attention to detail by the Hospitals Commission. The whole subject has been placed under the charge of Mr. T. B. Kidner, formerly at the head of technical training in the schools of Calgary, who also had experience in similar institutions in England, Nova Scotia, and New Brunswick. He has chosen to assist him in the various districts of Canada competent educational officials who have also been men of wide experience and some of whom are devoting their whole time to this work. Mr. Kidner has studied the experience of France and Britain and has improved upon their methods, inasmuch as he has systematized under one authority all this work, which has been done in these other countries by various unconnected, inexperienced, and unco-ordinated, though patriotic, organizations. This has led to uniformity and an absence of overlapping in the work here, and, although the work of the commission in this field has been of short duration, the progress attending it has been such as commends itself to this committee.

Objects of Training

The commission, apparently, has three objects in view in their system of training and re-education. In the first place, they have learned that the life of idleness usually prevailing in a convalescent home for soldiers has a bad influence upon the inmates, both physically and morally, and they are, therefore, giving them vocational training, not only to make the men better physically, but also in order to keep them occupied and out of mischief, and for the further reason that it has a great therapeutic value, and assists the men materially in their recovery. Their second object is to improve the men's elementary education, and, in addition, to make them more competent to carry on the occupations in which they have been engaged. The third object is, in case a man is not able to carry on his previous occupation, to re-educate him in some other occupation for which he is fit, so that he will not become a burden to society.

Since this work has been begun, and up to the middle of January of this year, vocational training during convalescence has been given to

538	patients in	Quebec.
141	"	the Maritime Provinces.
348	"	Ontario.
105	"	Manitoba.
101	"	Saskatchewan.
122	"	Alberta; and
148	"	British Columbia.

The commission, in pursuing this policy, has, as far as possible, attached to every convalescent home a staff of competent teachers for the purpose of carrying on this work, and has even, where the same is advisable, built special vocational instruction buildings as additions to the convalescent homes. At the Mowat Sanitarium, Kingston, and the Mountain Sanatorium, Hamilton, excellent buildings for vocational training have been completed; and since the meetings of this committee began, buildings are being erected at North Toronto (Military Orthopaedic Hospital), Halifax, N.S. (Camp Hill Hospital), Esquimalt, and Resthaven Hospitals, British Columbia. At Winnipeg, at the old agricultural college, the machinery hall, 100 feet square and three storeys high, will be devoted entirely to vocational training and the re-education of the seriously disabled men. Plans are also made for vocational buildings at other centres.

In the early stages of this work the commission was confronted by the reluctance of the soldiers to receive vocational training on account of the fear they entertained that if their earning power was thereby increased their pensions would be decreased. As a result of this experience, which was duplicated by the experience of Britain and France, an order-in-council was passed, very fittingly, declaring that the pensions of returned soldiers would not be decreased on account of their increased capacity to earn through their vocational training.

Wide Range of Subjects

The range of vocational training and re-education adopted by the commission has been very wide, indeed, extending to such subjects as woodworking, shoemaking, gardening, poultry-raising, farming, motor-mechanics, massage, telegraphy, bookkeeping, basket-making, sign-painting, typewriting, shorthand, mechanical drawing, and other occupations, full details in regard to which can be found from page 84 to page 160 in Volume II. of the evidence taken before the committee.

Fortunately, so far very few blind soldiers have returned to Canada, and those who have come back have been educated in the work of massage and typewriting, and have shown great progress in those occupations.

The teachers employed in the various convalescent homes, except in the Province of Ontario, are employed directly by the commission. In that province, for constitutional reasons put forward by the provincial government, teachers have been employed by the Provincial Soldiers' Aid Commission, but subject to the approval of the Hospitals Commission.

It is only fair that a considerable amount of voluntary assistance in teaching in the various schools has been given by patriotic persons, and that the commission has adopted the policy of using the returned soldiers who showed proficiency in various lines of education as instructors in their institutions, and remunerating them therefor.

Selection of Occupations

The policy adopted in regard to vocational training is to allow the convalescent to some extent to choose the occupation in which he shall receive training, guided, of course, by the officials of the commission. For the purpose of deciding general questions as to the most suitable training to be provided in a locality the commission asked the provincial commissions to appoint an advisory committee on training. (See page 3, Bulletin No. 2, M.H.C.) These advisory committees usually include:

1. Some person acquainted with the process of education.
2. An agricultural educationalist.
3. An employer.
4. A labor representative.

The procedure adopted to determine whether or not a man is eligible for re-education is as follows:

Each man who, from his medical record, appears likely to be unable to follow his previous occupation, is specially examined by a small board, known as a "disabled soldiers' training board," composed of three persons, namely:

(a) The district vocational officer;

(b) The medical officer in charge of unit; and

(c) A member of the Provincial Advisory Committee on Training.

The findings of the board are transmitted to the head office of the commission, and, if approved, the vocational officer is notified to arrange for the training of the men in some suitable institution or private establishment.

Many Factors Influence Choice of Subjects

The question as to what new occupation a disabled man may be trained for is clearly, first of all, a medical one. But it is a question for a technical specialist or "vocational counsellor," a man well versed in a knowledge of the methods of various industries and of the training necessary for those who desire to pursue them. But, further—and this is an important consideration—it is an economic question, touching the law of supply and demand. While there are a number of occupations for which it is not difficult to train men, it does not follow that employment can readily be obtained in them. Last, and by no means least, the man's own wishes and desires for his future must be consulted.

The question, therefore, is an individual one, and every case is investigated separately. The decision as to the occupation for which an opportunity of being trained is to be offered a man, is made in the light of the medical, training, economic, and personal factors of his case, but an endeavor is always made to have him take up some work in which his former training will not be wasted, and some form of employment, also, in which there is active demand for workmen. For instance, supposing a man had been a painter, but on account of shell-shock was unable to continue in that occupation because of vertigo, he would be re-educated so as to make him a sign-painter.

Advantages of Training Acknowledged

Twelve thousand men had by the middle of January passed through the hands of the Hospitals Commission, and of this number in the neighborhood of fifteen hundred had received vocational training and had passed into civil life, and many have, by letters, acknowledged the advantages they had received from the education given by the commission. This work of re-education was only begun by the commission at the end of June, 1916, but at the end of February, 1917, 108 cases were undergoing re-education. Some 12 cases had concluded their courses very successfully, but the number is probably too small to found any definite conclusion upon. The question arises as to what extent re-education should be undertaken by the commission, because the process may be long and may be very expensive to the state, and is possible of abuse on account of insincerity of those undertaking it in some cases. A further question arises as to whether it would be wise for the commission, after the discharge of a soldier who has then not been able to get along in life, to re-enlist or enroll this soldier for the purpose of re-education in some occupation in which it might be possible that he might succeed.

The question of increasing the subsistence allowance to men undergoing re-education was also considered, but your committee has been informed that by order-in-council, No. 976, dated April 12, 1917, the rate of pay for subsistence of men living out during re-education has been raised from 60 cents to $1 per day, which would seem to meet the case. The same order-in-council also widened the scope of the definition of "dependents" of men undergoing re-education in a satisfactory way. Under the order-in-council (copy attached) a scale of payments for men undergoing re-education, and for their dependents, is provided.

Payments under these regulations are continued for one month after the completion of vocational training, whether the man has secured employment or not.

Provincial Co-operation in Securing Employment

At present the question of securing employment for the returned soldier is left largely in the hands of the various provincial soldiers' aid commissions.

In Ontario by the Soldiers' Aid Commission, of which the Hon. W. D. McPherson, Provincial Secretary, is chairman.

In Quebec by the Soldiers' Employment Bureau, of which the Hon. George A. Simard is chairman.

In Nova Scotia by the Returned Soldiers' Employment Committee, of which the Hon. R. M. McGregor is chairman.

In New Brunswick by the Returned Soldiers' Aid Commission, of which Mr. Thomas S. Bell is chairman.

In Prince Edward Island by the Returned Soldiers' Committee, of which the Hon. A. J. Mathieson is chairman.

In Manitoba by the Provincial Returned Soldiers' Commission, of which Sir Daniel McMillan, K.C.M.G., is chairman.

In Saskatchewan by the Returned Soldiers' Employment

Commission, of which the Hon. Mr. Justice Elwood is chairman.

In Alberta by the Provincial Central Committee of the Military Hospitals Commission, of which Mr. Howard Stutchbury is secretary.

In British Columbia by the Returned Soldiers' Commission, of which Dr. H. E. Young, Victoria, B.C., is chairman.

These provincial bodies were created as a result of the inter-provincial conferences with the Military Hospitals Commission, held in Ottawa on the 19th and 20th of October, 1915, at which it was agreed inter-alia:

"That each province should assume the responsibility of finding employment for discharged soldiers who, upon their return to Canada, are physically or otherwise fit to assume such employment, and all expenditures necessary in undertaking this duty are borne by the province."

At this conference, however, it seems to have been made plain that the question of finding employment for the physically fit returned soldier concerned only the problems which were those pressing for the moment, and not the provision of securing employment for the whole forces on demobilization.

Work Secured for All Applicants

Up to the present time the various provincial bodies above enumerated have, through their branches in the several provinces, assumed the responsibility of providing employment for the returned soldier, and the evidence given before your committee satisfies it that they have found employment for all returned soldiers desiring such, and within a reasonable time from their application therefor.

Of those members of the Canadian expeditionary forces who have returned from overseas and sought re-employment through the above agencies, only a small percentage have expressed a desire to follow an agricultural occupation. This would appear to be partly due to the fact that those who have already returned are mostly members of the earlier divisions enlisted, and, consequently, were composed to a large extent of the urban population of Canada. It is probable, however, that a larger percentage of those returning in future will express a desire to go upon the land, and your committee would recommend that all reasonable efforts be made to have returned soldiers take up farming, or market gardening, as an occupation, where there is a reasonable probability of them making it a success. As the land settlement question is now before the House and much legislation has been passed by the various provinces, it is not deemed advisable by this committee to go further into this question than to submit the evidence taken thereon.

Preference Given Returned Men in Civil Service

Under order-in-council (P.C. No. 2758) it is provided that in all appointments to the government civil service, preference be given to returned members of the Canadian expeditionary forces, especially those who, through disability occasioned by active military service, are unable to follow their previous occupation, such appointments to be subject to the provisions of the Civil Service Act, and to be made with regard to the qualifications of the applicant.

By further orders-in-council it is provided that no person shall be appointed to the civil service unless he is under or over military age or presents evdience that he has offered himself for enlistment and has been refused as unfit.

Your committee finds that returned soldiers are being given preference in accordance with the above provisions in all appointments to the civil service, and in other appointments by the various departments.

Upon the evidence before your committee, it appears that where a soldier is a civil servant at the time of enlistment, there is no provision that his time spent on active service should count as though he had been granted leave of absence.

Your committee is of opinion that the pension scheme wisely determines the amount of pension on the basis of injury received, without regard to subsequently acquired earning capacity, so that a pensioner is thus encouraged to make himself more efficient, physically and economically, knowing that his pension will not be decreased thereby.

Much evidence was given before your committee respecting the problem of providing employment for the whole forces upon demobilization and returning them to civil life.

Trade Publications

The Barrett Company are distributing a new booklet illustrating and describing the different applications of the Holt roof connection for leaders and vents. It is claimed by the makers that this is the first and only leak-proof and trouble-proof device on the market.

Air Compressors.—Bulletin K-300-A, illustrating a line of power-driven, single stage, straight line air compressors manufactured by the Canadian Ingersoll-Rand Company, Limited, of Montreal. These machines are designed for motor or belt drive and are furnished with a special short belt drive where floor space is a consideration. They are intended for use in industrial and mining plants where units of 9,950 cubic feet displacement and under, per minute, are required. Eighteen sizes are built giving a wide range of choice. "CIRCO" leaf inlet and outlet valves and the dust proof, self-oiling and self-contained construction of this type of compressor are fully described.

Mainly Constructional

East and West—From Coast to Coast

Building permits issued in the city of Regina, Sask., during the month of June totalled $44,525, as comared with $7,700 for the same month last year. The value of the permits for the first six months of the year amounts to $148,640, as compared with $62,400 for the corresponding period in 1916.

A recent fire in the International Engineering Works plant, at Amherst, N.S., did damage estimated at between $75,000 and $100,000. The blaze originated in the pattern storage building and spread rapidly, completely destroying that structure. Other buildings were threatened, but escaped the conflagration.

The Council of Elgin County recently decided to fall in line with the good roads movement in Ontario, and has passed a by-law providing for the adoption of a system of good roads under the Ontario Highways Act. It is understood that actual construction work will not be undertaken until after the war. The proposed scheme includes 250 miles of roadway.

The Water, Power and Light Commission of Weston, Ont., recently ordered the preparation of plans for the reconstruction of the sedimentary basin and the laying of a new in take pipe in connection with the town's waterworks system. This action was taken upon a special report by Engineer E. A. James, who advised immediate adjustment of the water system owing to the inadequacy of the present equipment.

An excellent type of rural roadway, five miles in length, is being built in Etobicoke Township, Ont., from the Humber to the Etobicoke River. It will be 24 feet in width—18 feet of asphalt, with 3-foot macadam shoulders on each side. The cost will amount to $14,000 per mile. The portion between the C.P.R. crossing at Lambton Mills and the Etobicoke River is being carried out at the expense of Sir John Eaton, this being a renewal of that piece of road built by him as a model some years ago. The remainder will be built by the York County Highway Commission.

The city of Kingston, Ont., are granting permission to the Kingston Shipbuilding Company to extend its plant 75 feet further into the harbor. The company requested this concession on account of the big increase in shipbuilding operations. They point out that last fall the Department of Marine established a new wharf or headline for Kingston harbor, and that the new line will enable the company to extend its wharf.

Work on the new centre span for the Quebec Bridge, which is under way at Sillery, is now about one-third completed, and it is expected that in September it will be again ready to hoist into position. No change is proposed in the method of putting it in place, and the operation is to be carried out in the same manner as last year. Every care is being taken to insure against any defect in the material which could cause another disaster.

At a recent meeting of the Essex Border Utilities Commission it was decided to apportion the cost of the proposed joint water and sewerage system for the six border municipalities as follows: One-quarter to be charged up to each municipality according to population; one-quarter according to area of the various municipalities from Ford to Ojibway, including Sandwich West; one-quarter according to capacity; one-quarter according to "capacity times distance."

The Ontario Department of Highways will present a somewhat unusual exhibit this year at the Canadian National Exhibition. It will consist of a permanent model highway, to be built under the supervision of Deputy Minister W. A. McLean. This road will be used to demonstrate to municipal officials from outside points the possibilities in accepted types of rural highway construction. It will be 160 feet long and 45 feet long, and will run through the agricultural section of the exhibition.

Industrial expansion at New Toronto and the corresponding increase in the population has created an acute demand for housing accommodation, and, as a result, the manufacturers themselves are undertaking the erection of houses to accommodate their employes. Brown's Copper and Brass Rolling Mills, Ltd., propose to erect 100 dwellings, to cost on an average about $2,000. This concern have already constructed 30 frame houses, each costing $1,500, but many more are required to supply the needs of their employes. Contractors also are busy on Ninth Street, where it is proposed to erect 46 residences.

Hon. F. G. Macdiarmid, Minister of Public Works for the Province of Ontario, has announced the decision of the Provincial Government to take over and maintain as a part of the provincial highway system that portion of the Kingston road between Toronto and Oshawa. This is the initial step in establishing the provincial system. Mr. Macdiarmid states that it is not intended to undertake any extensive scheme of highway construction at present, but several gangs of men are to be permanently employed on the road in order to keep it in a state of repair. The government will assume 70 per cent. of the maintenance cost and the municipalities will pay the remaining 30.

Personals

Mr. A. V. Redmond, resident engineer on the Canadian government railways at Cochrane, Ont., has been appointed division engineer.

Mr. J. H. Clothier has been appointed district engineer of the Northeastern Mineral Survey District, with headquarters at Prince Rupert, B.C.

Mr. J. C. Beckwith, engineer of construction on the Canadian Government railways, has been appointed division engineer, with headquarters at Moncton, N.B.

Mr. F. B. Tapley, assistant engineer of the Canadian government railways at Moncton, N.B., has now been appointed assistant engineer of maintenance for all lines.

Mr. Arthur Vincent, C.E., has been appointed town engineer of Longueuil, P.Q., in succession to the late Mr. F. Barbeau. Mr. Vincent was formerly alderman of the town.

Lieut. C. S. DeGruchy, formerly assistant engineer on the Halifax Ocean Terminals, is reported wounded. He is serving with a unit of the Canadian artillery, and was awarded the Military Cross for his work during the Somme offensive.

Mr. Albert G. Langley, M.E., consulting mining engineer, of Vancouver, has been appointed district engineer of the eastern mineral survey district, with headquarters at Revelstoke. Mr. Langley is a graduate of McGill University, and for some years has been practising his profession in British Columbia.

Mr. F. C. Gamble, chief engineer of the British Columbia Provincial Department of Railways, was recently dismissed from office by Hon. John Oliver, Minister of Railways. No statement was made by the minister as to the reason for this action. He has also discharged Mr. H. A. Icke, engineer in charge of the improvement work on the former Songhees Reserve. Mr. Gamble has been in the provincial service since 1898, when he was made chief engineer for the province, and in 1911 he was appointed chief engineer of the Department of Railways, in which capacity he has served until his recent dismissal. He is a past president of the Canadian Society of Civil Engineers.

Obituary

Mr. Edward Gillespie, a carpenter and builder, of Belleville, Ont., recently passed away. His death was sudden and quite unexpected.

Mr. F. S. Henning, superintendent of the Toronto Island filtration plant since 1910, is dead, at the age of 59. Mr. Henning was born in St. Catharines.

Mr. Charles Jenvey, a pioneer resident of Oxford County, Ont., died recently at Ingersoll, in his eighty-sixth year. Mr. Jenvey was a native of England, and came to Canada in 1855. In 1866 he established a brick and tile yard at Springford, which he conducted for twenty-seven years.

France Desires to Build Her Own Houses

The annual review of the work of the Canadian Commercial Intelligence Service has recently been issued. The report contains a few matters of interest to contractors. In regard to the portable house industry and trade it states that six models of portable houses were sent to Paris about midsummer of last year and were set up in the Tuilleries Gardens, a short time after the opening of the Reconstruction Exhibition held there. Mr. Frank Pauze, of Montreal, a member of the Canadian Trade Commission which visited France, furnished valuable information to several builders who made enquiries regarding portable houses. The six model houses were presented to the "Secours National," and are being utilized by the Canadian General Hospital No. 8, at St. Cloud. It was ascertained, the report says, that the policy adopted by the French authorities would be that the construction of houses for the devastated regions should be undertaken as much as possible in France.

The Council of the city of Los Angeles, Cal., has just adopted specifications for the construction of sanitary sewers within the city which permit the use of concrete sewer pipe.

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Principal Contents

The After-War Status of Labor

PROBABLY one of the most difficult problems which will have to be dealt with when war is over is the relationship between employers and employed. The abnormal conditions applying to the labor situation at the present time add complications to the solution of the subject. This matter was dealt with in the presidential address of Mr. Philip H. Palmer before the Institution of Municipal and County Engineers. The portions of his address applying to labor relations are as follows:

The present condition of labor, owing to the war, is abnormal; and, owing to the high rate of wages paid to both skilled and unskilled labor, together with the large amount of female labor employed, will form one of the most difficult problems to solve.

Strikes or industrial war put a stop to successful industry and nullify schemes for development. At the present time there is talk of all sorts of schemes for promoting industrial activity and making good deficiencies revealed by the war, but, after all, these ideas will be brought to nought unless we can prevent industrial strife. This matter does not seem to engage the attention of legislators, employers of labor, and the public in the way it should. The period immediately following on the cessation of war will be a very critical one for the future of industries in general, and if labor ceases its activity in large bodies, opportunities will be lost of acquiring industries and which would again be driven into the hands of workmen and capitalists of other countries.

In order to prevent such industrial strife very great forbearance will be required, both from the trades unions and employers. It is natural that the employee should to a large extent wish to participate in the prosperity of the employer, and he, of course, looks for his part of this prosperity in higher wages, and it ought not to be a difficult matter to form arbitration boards to adjust differences and means to compel both sides to accept such awards. The matter, however, of dealing with labor and production after the war will be one of the most difficult and thorny problems confronting parliament; and only bold departures from previous methods and rules, undertaken in a new spirit and with great resolution, can prevent strife in some industries, which would have the effect of paralyzing others.

This war has shown what women can do in the field of labor, and there will be no doubt a vast amount of female labor retained permanently. The brains of very many women are quite as good and capable of development as those of many men; and in the more democratic times before us we, no doubt, shall see women take a different status in life from that which was considered proper before the war; whether to the advantage of the race and mankind in general can only be determined by time, and it remains to be seen whether women in authority will develop the same amount of ballast and tact as generally is supposed to be among the principal attributes of a man in a similar position.

Women in Engineering Industries

IN Canada women have been employed for some time in the munition and allied engineering plants, but not to the same extent as in England. In these troublous times British women are accomplishing wonderful things in all branches of engineering activities. The Electrical Review, of London, has recently discussed the question of women in the engineering industries in an article which is abstracted below:

The manner in which women have come to the assistance of the Empire in taking the places of men of fighting age and fitness and in facilitating the most necessary work must fill us all with admiration, but it is of the greatest possible importance that the movement, with its magnificent record, should not stop where it is. There is need for the employment of female labor to be carried much farther than it has yet gone, for the number of fighting men must be increased continuously until the enemy has been utterly defeated, yet the output of munitions for our men must be maintained at all costs. Of course, it is no new thing for women to be engaged in lamp-making, armature-winding, accessories manufacture, and so on, but at a recent exhibition in England there was brought together a collection of articles of many other kinds upon which women have brought their now proved adaptability and deft fingers to bear. Sparking plugs, complete magnetos, lamp-holders, armature parts, lighting switchboards for mechanical transport work and scientific instruments, are among the purely electrical examples upon which women have worked either at drilling or milling, winding, engraving, assembling, and so forth. But the collection of photographs carries us into classes of labor where before the war female labor, if not unknown in this country, was almost a curiosity. They depict women engaged in a host of operations involved in general engineering, shipbuilding, and marine engineerin tool-room and precision work, small arms work, and the manufacture of parts of internal combustion engines. They show them engaged on wiring and rolling mills, operating all kinds of lathes and similar machinery, building small commutators, operating presses for armature work, assembling ironclad switchgear, erecting switchboards, driving 40-ton cranes, in charge of motors on industrial installations, driving electric trucks, electrically welding electric contact mines, operating a 500 kw. switchboard, and attending a 300 kw. direct coupled engine set and a 1,000 h.p. steam engine.

Fear and suspicion on the part of male workers as to the position of certain classes of trades after the war, consequent upon the change, still lurk beneath an apparently calm surface; unwillingness and want of conviction as to the suitability of women for certain classes of work still mark the attitude of some employers; and many women continue to show a predilection for classes of service which normal times have proved to be their natural avocations. But we are governed to-day by the dictates of absolute necessity, and for the time being all will do well to pack up their prejudices, as the soldiers do their troubles, and find a way for doing their bit to further, in the interests of the great cause of civilization, the employment of women in the engineering factories of the United Kingdom.

If the call of the War Office is for men of fighting age and fitness, that of the Ministry of Munitions is for women, more women, and still more women, for our factories, in order that those fighting men may do their part with a minimum loss of life, and, by hastening the end, save millions of treasure also.

Our after-the-war problems may seem to be increased with each successive step forward in disorganization, but who can show suitable alternatives to present methods? Further, may it not well happen that instead of being detrimental to the national industrial situation that follows the war, the availability of a vastly larger volume of skilled and semi-skilled female labor will be an asset of immense value when we resume the manufacturing operations of pre-war times on what we hope will be an exceptional scale, calling for the co-operation of all the demobilized fighting men, and all the new industrial women, in the building up of greater industries than have ever been ours in the past?

Helping the Householder with His Heating Problems

Apropos of the shortage of coal and the necessity for conserving its heat value to the greatest possible extent, the Engineering Experimental Station of the University of Illinois has prepared a booklet (which sells for 10 cents), entitled "The Economical Purchase and Use of Bituminous Coal for Heating Homes, with Special Reference to Conditions in Illinois." The booklet is of general interest, however, as the following brief review will show:

"The University of Illinois has discussed, in the circular referred to, the more important factors involved in the installation of a satisfactory house heating system, and has set forth the most economical methods of firing soft coal and operating a house-heating plant. The properties of fuels and the processes attending their combustion are discussed in a fashion which is intended to help the average householder to understand his problem and to secure the economics of intelligent operation.

"Tables giving the trade names, geologic names, and average heating value of the coals of the Central Western area are contained in the circular, and a chart is presented to show the relative worth of coals of different heating values. Some attention is also given to the properties of Eastern coals.

"Diagrams in color illustrate the usual heat losses which occur, and suggest the means to be employed in overcoming them. Methods and devices for regulating house-heaters are shown by drawings, and the importance of proper chimney height, of air-tight flues, and of various dampers and regulators is emphasized by a number of illustrations."

Stationary Engineers Hold Convention and Exhibit

The Canadian Association of Stationary Engineers held their annual convention during the week, July 23-28, at 70 King Street West, Toronto. The exhibition of manufactured products was a prominent feature of the convention, nearly fifty manufacturers availing themselves of the opportunity of displaying their equipment. Among those having prominent exhibits may be mentioned the following: George W. Cole, Ltd.; Darling Brothers, Montreal; Garlock Packing Company, Hamilton; Goldie & McCulloch, Galt; Canadian Allis-Chalmers, Toronto; Allen General Supplies, Ltd., Toronto; Lyman Tube and Supplies, Montreal; S. F. Bowser & Co., Toronto; Dunlop Tire and Rubber Goods Company, Toronto; Dominion Belting Company, Hamilton; Federal Engineering Company, Toronto; James Morrison Brass Manufacturing Company, Toronto.

Next year's convention will be held in London, June 25, 26, 27. The officers for the coming year are: President, R. G. Gofton, Kitchener; vice-president, William Cooke, Belleville; secretary, John H. Hale, Hamilton; treasurer, A. W. Heath, Toronto.

Saving Chimneys by the Cement Gun

An old octagonal brick chimney 125 ft. high and 12 ft. diameter, belonging to the Solway Process Company, Detroit, had become badly weathered so that large quantities of mortar had fallen out of the joints and much of the brick was eaten away to a depth of several inches. The exterior surface was first cleared by the removal of all loose material and then the entire structure was enclosed by triangular wire mesh, furred out about 1 in. all around, and upon this concrete was shot by cement guns, forming a solid mass with a minimum thickness of 2 in. The air pressure employed was 50 pounds, and the cost of the job about $1,500.

The cement gun was used with success and satisfaction for the cement lining 1¾ inches thick applied with an air pressure of 35 pound gauge, to the interiors of five large steel smokestacks recently built for the Ford Motor Company, Detroit.

Nine-Mile Sewer in Cut and Tunnel

Contractors' Methods of Installing Large Intercepting Sewer—Tunnel Work Speedier and More Satisfactory on One Contract

In a paper recently presented before the Western Society of Engineers, Mr. H. R. Abbott, assistant engineer of the sanitary district of Chicago, described the methods of work, construction problems and their solutions on eighteen miles of intercepting sewer construction in Chicago. This work was partly in tunnel and partly in open cut. Because of the special features pertaining to this work the following extracts from the paper are reproduced. The details apply to a nine-mile portion of the sewer, known as the North Shore intercepting sewer, intercepting in all nine sewer outlets. The work was divided into three contracts—Nos. 1, 2, and 3, having lengths of 2.7, 1.3, and 4.7 miles respectively.

Contract No. 1 was built entirely in open cut, the average cut being 21½ feet. The excavation was made by a Bucyrus 70-ton steam shovel, mounted on timbers to span the trench, and fitted with a 54-foot dipper handle. In the maximum cut of 26 feet some hard work was required on account of the excessive depth. The average daily progress for an entire working season was 70 feet, or 480 cubic yards of excavation. The maximum daily run was 125 feet, or 850 cubic yards of excavation. All sheeting was left in place, to prevent any sloughing of the banks, but largely, however, to protect the adjacent local sewer and water pipes, although the entire section was in good, stiff blue clay.

Traveler Places Forms

The sewer section of this contract is egg-shaped, built of monolithic concrete of 1:2½:5 mix, and is 6 x 9 feet in size, merging into a 6 x 8 ft. The slopes are 1 in 2,000 and 1 in 2,500. Blaw steel forms of a collapsible type were used, the sections being 5 ft. in length. Both invert and arch forms were carried ahead by travelers. The arch traveler was 12 ft. long, and carried 15 ft. of form per trip. This traveler was carried on 9-in. flanged wheels, running on a small T-rail, supported on cross timbers placed about 3 ft. above the invert. The invert traveler carried one 5-ft. length of form ahead each trip, suspended from a small boom equipped with wire rope, cleaves, and winch. The rear end of this traveler was counter-weighted to maintain stability. For the job 130 ft. of invert and 200 ft. of arch forms were employed. The invert form was supported on concrete blocks 9 x 10 x 14 in., spaced 5 ft. centres. These blocks were cast outside the trench and cured, being placed to line and grade as soon as the bottom was shaped up, after which the space between the blocks was filled with concrete from the mixer. The concrete mixer was mounted to span the trench and deposited the concrete through a flexible jointed chute.

All material was teamed to the work, the average haul being 1¼ miles. Spoil was loaded direct from the shovel into 2½-yard dump-cars and hauled to the dump or back fills. Seven cars formed an average train. The dump was situated in a ravine and near the middle of the contract.

Four sewer outfalls discharging into Lake Michigan were intercepted on this contract. These were provided with spillways utilizing the old sewers between the interceptor and the lakes as overflows for excessive storm flow. An output of 0.8 ft. of completed sewer per day per man was obtained.

Excavating Machine for Open Cut

Contract No. 2 comprises a modified ellipse-shaped sewer 62 in. in size, built partly in open cut and partly

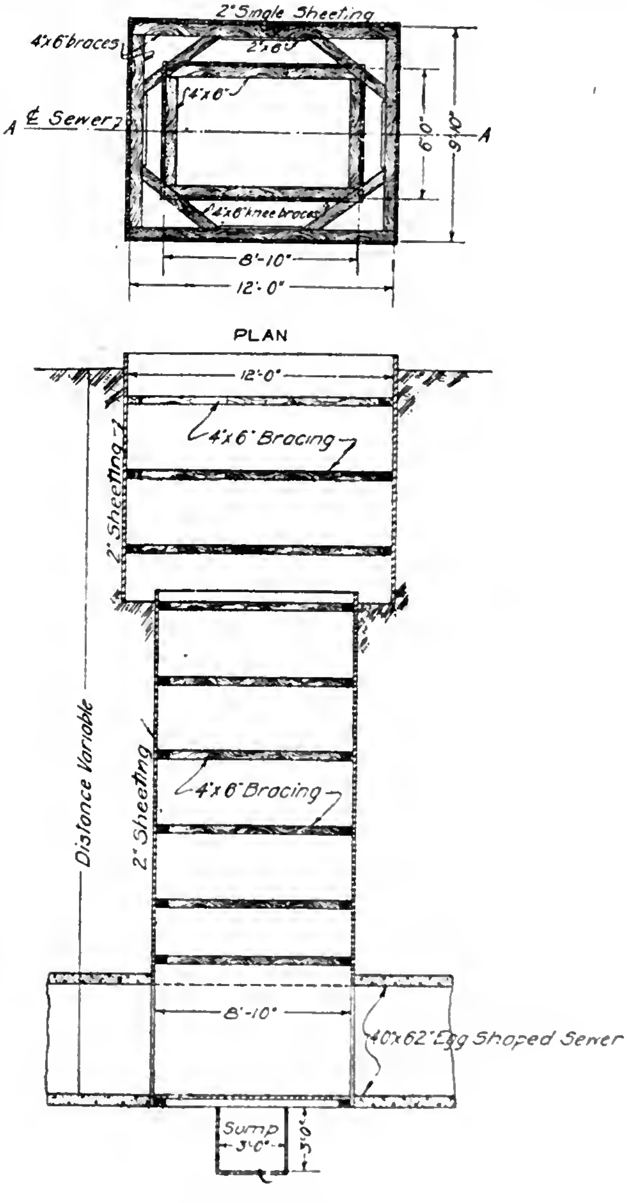


Fig. 1.—Timbering plan for shafts.

in tunnel, with a slope of 1 in 1,250. On the open cut section a Parsons excavating machine was used, spoiling alongside the trench. As the work was in an unpaved street, continuous sheeting was not used. Several cave-ins occurred, due to leakage from an existing tile sewer, which in places was exposed in the side of the trench. The Blaw forms used on this section were in

5-ft. lengths, five lengths being bolted together as one unit when moving ahead. The concrete invert was laid ahead, the invert forms then being dragged ahead by block and tackle. The arch forms were equipped with 5-in. castor wheels bolted to the forms, and were carried on wooden stringers supported on cross-timbers. The collapsing of the forms was done with a turnbuckle attached to the forms and also serving as a cross-brace. Fifty feet of invert and the same amount of arch forms were used on this section.

Concrete was mixed in a 10-ft. capacity Whirlpool gas engine mixer and chuted into the work. Very little excavated material was hauled away, and back-filling was done by teams. The output was 0.66 ft. per man per day, or a daily average progress of 25 ft.

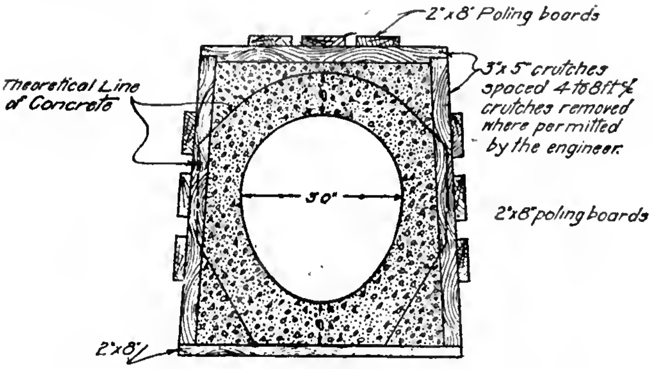


Fig. 2—Method of timbering for 30, 33 and 36-in. ovoid concrete sewers laid in tunnel.

Tunnelling Methods

On part of this contract the sewer was built in tunnel. Three shafts were sunk at an average distance apart of 1,400 feet. The shafts were rectangular and 6 x 8 ft. inside of timbering (Fig. 1). In sinking the shafts the excavated material was scaffolded up. The work in the tunnel was carried on 24 hours a day, in three shifts, two mining and one concreting. Owing to the nature of the ground very little timbering was necessary, occasional crutches and light poling boards being used where the roof showed a tendency to slough off. In all such cases the poling boards were concreted in, but the crutches were removed. A regular mining program of 10 ft. for each eight-hour shift in each heading was followed. This 20 ft. mined each day was lined in the 8-hour concrete shift, making a total progress of 40 ft. in the two headings every 24 hours. This is equivalent to 0.85 ft. per man per day. Concrete for lining the tunnel was mixed at the top of the shaft by hand, loaded into muck cars, and pushed by hand to the headings. A strongly-timbered two-storey headhouse carried the elevator, which was operated by a steam hoist. The muck was raised to the second landing and run out onto a dump track, to be dumped onto the muck pile or into wagons. At the completion of the tunnel-work driven from any one shaft, the headhouse, hoist, and boiler were moved on to the next shaft. Ventilation for the tunnel was furnished by blowers operated by a belt from a special engine. The Blaw forms for this tunnel section were the ordinary knock-down forms, consisting of ribs and lagging plates, the plates being 5 ft. long and 18 to 21 in. in width; 80 lineal feet were used on this section.

Tunnel Work More Satisfactory

Contract No. 3 included 36, 33, 30-in. ovoid-shape concrete and 24, 18, 12 and 9-in. tile sewers, beginning with a slope of 1 in 1,500 and gradually increasing to 1 in 540 upper end. This contract section was specified to be built in open cut, except the 2,400-ft. of 24-in. tile. The contractor, however, after building the first 1,100 feet north of the junction with Contract No. 2, and making very unsatisfactory progress, decided to build all of the balance in tunnel. The open-cut work showed that the tunnel would be in fairly good clay, although the first 6 ft. below the ground level was a very sandy loam, and would give trouble in an open cut unless Wakefield sheeting was used. Shafts were sunk at short intervals for the entire balance of the work, or 3¾ miles, this stretch having 92 shafts, with 184 headings. The headings averaged 207 ft. in length on the 36, 33, 30, 18, and 12-in. sections. The total length of shafts of this character was 1,943 lineal feet, or just about 10 per cent. of the entire length of the tunnel as built from these shafts. An average day's progress on this work was 57 feet, including the shaft work, or very nearly 1 foot per man per day, as against a progress of but 25 feet per day on the 1,100 feet done by open cut on the same sewer. Owing to the extremely small working space in these sections it was impossible to concrete the sewer as the work progressed. The expedient was, therefore, adopted of mining continuously between shafts and concreting the whole length of the heading, from the face back to the shaft, after the mining had been completed (Fig. 2). These shafts, averaging only 21 feet in depth, were circular and 6 feet in diameter, using the ordinary sewer iron rings and 2-in. wood lagging. They were sunk by two special crews, the first excavating and sheeting the shaft to a depth of 10 feet and scaffolding out the material. The second gang completed the shaft and usually cut and timbered the eyes, hoisting the material out with a carriage wheel winch, such as is used for lowering pipe into a trench, but geared up to give more speed.

Little Plant Used

Because of the frequent shifting required, very little plant was used. Two light two-storey timbered headhouses, built on skids, were used, one being in operation at the shaft where mining was under way, while the other was set up at the shaft ahead. The power plant was a single drum hoist and a portable 30-h.p. boiler. The whole outfit was moved ahead, set up, and put in operation in less than two hours. Muck was brought from the face to the shaft in tubs carried on small flat cars. No elevator was used, the tubs being hooked directly onto the hoisting table, raised to the second landing of the headhouse, and dumped into the spoil wagons. Concrete was mixed in a Whirlpool gas

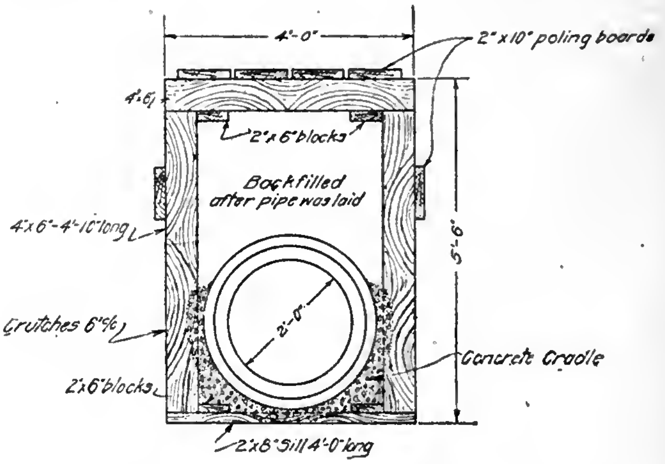


Fig. 3—Method of timbering for tile sewer laid in tunnel.

engine mixer of 10 cubic feet capacity and chuted down the shaft into dump-cars, which were pushed to the headings. Forms were removed by a special gang after the concrete and mining gangs had gone on to the next shaft. This gang also pointed up, plastered the invert and concreted up the opening at the shaft. The forms used in concreting the shaft opening had to be removed through the next shaft. Sand pockets of considerable extent encountered along a stretch of three-quarters of a mile prevented the work being done in tunnel at these points with the means at hand. The work at the places was then carried on by the open-cut method, making the excavation by hand, the open cutting in eight separate pieces totalling 723 feet in the three and three-quarter miles of work. These open-cut sections proved very expensive to the contractor. Built-up wooden forms were used on the 33 and 30-inch sections, and the Blaw steel forms on the 36-inch section, using 128 feet of the steel forms and a similar length of wood form on the other two sections. All material was delivered by teams, and for about one-half of the contract section it was necessary to lay plank roadways extending from the end of the nearest paved street to the site of the work. The planking in these roadways, however, was taken up and used again and again. The average haul for material was 1½ miles. Four outfall sewers were picked up on this contract, intercepting the sewage which formerly flowed away in open ditches.

Tile Sewer Section

The 24-in. tile section was specified as tunnel in the contract; it was driven from four shafts, averaging 49 feet in depth, spaced approximately 1,000 feet apart, making the heading 500 feet long. All shafts were sunk at the site of manholes, and other manholes were built in specially excavated wells between the shafts. The shafts were similar to shafts described on Contract No. 2. Excavated material was scaffolded out to a depth of 12 feet ,after which a windlass mounted on a tripod hoisted out material in buckets. Excavation for the intermediate manholes was made in circular wells 4 ft. 8 in. in diameter, sheeted with 2 in. lumber secured in place by steel rings and material hoisted out by a windlass. No trouble was encountered in sinking these wells to a maximum depth of 60 feet.

From these shafts the mining was carried on continuously for the full length of the heading, the tunnel being timbered as the work advanced and track laid. Muck cars of ½ cu. yd. capacity were used and hoisted to the second landing of the headhouse and muck dumped into wagons. As soon as the headings were completed the tile was laid in a concrete cradle (Fig. 3), beginning at the far end of the heading and working back to the shaft. Tile was brought in one at a time on the dump cars, the sides of the car being removed. All joints were caulked with jute soaked in cement grout and plastered. The backfill was brought down the shaft in the muck cars and packed over the pipes as laid, the usual procedure being to lay about four lengths of pipe and then backfill. This section was in uniformly good, stiff blue clay, and work was performed under a sub-contract.

More Permanent Plant

A more permanent plant was used on this job than on the 36, 33, and 30-in. concrete sections. The headhouse was a heavily timbered two-storey affair, equipped with a 6-foot cage elevator. A dump track was laid from the second storey out over a dumping trestle, under which the wagons could drive. Hoisting plant consisted of a double-drum hoist operated by a 40-h.p. vertical boiler. A small blower was geared to the shaft of the idle drum to furnish air for ventilation and operated as needed. No compressed air was used. At the completion of the work from one shaft, the boiler, hoist, and headhouse, all mounted on skids, were moved ahead to the next shaft by teams pulling with block and tackle from deadmen. Two days were required to move and re-assemble the plant.

For connecting local sewers a cast-iron drop pipe was built, extending from the connecting sewer down to the 24-in. sewer and carried outside of the manhole. The drop pipes were encased in concrete. The work on the 18 and 12-in. tile sewers on the extreme end of the contract was carried on in a similar manner to that employed on the 36, 33, and 30-in. sections except that the shafts were closer together. An average daily progress on the 24-in. tile in tunnel was 41 ft., or 1 ft. per man per day.

Flat Slab Factory Building

At Chambly Canton, P.Q., for Manufacture of Leatherboard—Three Storeys, 300 by 50 ft.

WORK is now in progress on a leatherboard factory for Bennetts Limited, at Chambly Canton, P.Q., on the banks of the Richelieu River. The site is 300 x 50, the building—45 feet in height—being of three storeys and constructed of reinforced concrete and brick. The foundations are of concrete, and the exterior of concrete and brick panels. A feature is the large amount of window space provided, the windows being of steel sash, with concrete sills and lintels.

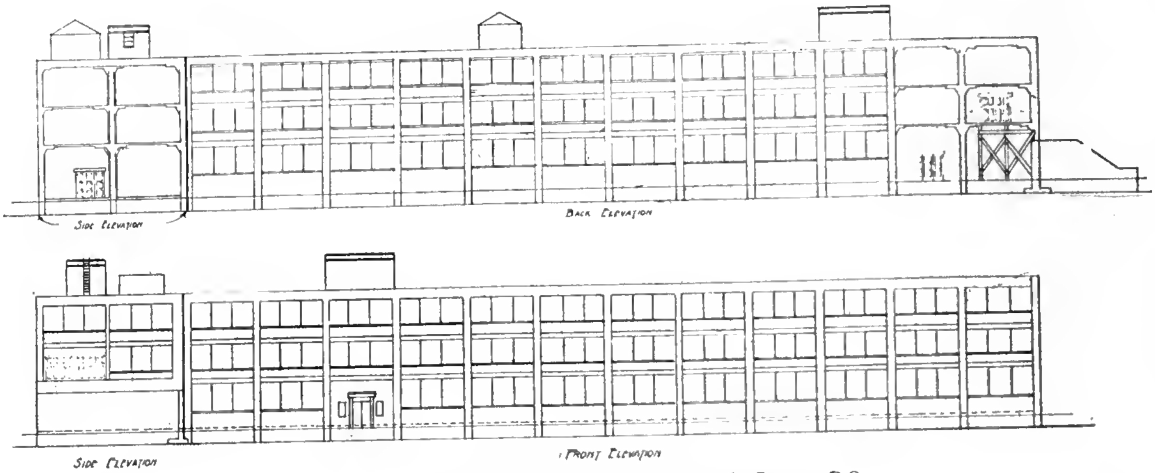
Eleven reinforced concrete columns run down the centre of each floor, while there are also 28 wall columns. The floors are of concrete, flat slab construction, the slabs being from 5 in. with 1 in. finish to 8 in. with 1 in. finish.

Retaining Wall

A large retaining wall 25 feet high, of reinforced concrete, has been constructed at one end, and on the top of this is a shipping platform 20 feet wide, built of lumber, with earth filling. This platform has a 3 in. x 8 in. flooring, and is enclosed by 1½ in. x 3 in. railings. The foundations of the retaining wall and building go down to rock. The platform has direct connection with sidings leading to the lines of the Central Vermont and Montreal and Southern Counties Railways.

There is a main entrance, of brick and stone, with the words "Bennetts Limited" placed above the doors. This entrance leads to a large elevator and stair tower, going up a few feet above the roof. The stairway is of concrete, and is provided with Mason's safety treads. At the top of the elevator a tank of 500 gallons capacity is located.

The lavatories, sinks, etc., are in the tower, while on the third floor are the offices, also in the tower, the offices being partitioned off by means of glass partitions, leading off the stairway. Entrance to the tower is obtained on each floor through sliding fire-doors built on each side of the tower. The roof is Barrett Specification, and is provided with a ventilation shaft 12 feet square. The heating will be by steam, and a small power-house will be built later. The heating pipes are carried in ducts alongside the wall on the first floor, then up the wall through the other floors.



Elevations of 3-storey flat slab factory at Chambly Canton, P.Q.

Connection will be made with the power-house by means of underground pipes.

A drain runs down each side of the building, leading direct to a 20-in. fire-clay drain, running into the Richelieu River. This enables the surface water, water discharged in the process of manufacture, and sewage to be discharged into the river.

Provision is made for future extension at one end, where the panels are built up with brick, which can be removed, and any extension connected with the present structure.

All the outside work is to be painted with Carbolineum paint.

The building is designed to carry 200 pounds per square foot live load, and was designed by T. Pringle & Son, Montreal, and the general contract is being carried out by Mr. G. B. Mitchell, C.E., Montreal. The reinforcing steel is supplied by the Trussed Concrete Steel Company of Canada, Ltd., Montreal; architectural iron, Mr. F. A. McKay, Montreal; mill work, Traversy, Ltd., Montreal; plumbing and heating, W. J. McGuire & Co., Montreal; roofing, George W. Reed & Co., Ltd., Montreal; painting, A. Craig, Ltd., Montreal; fenestra sash, Steel and Radiation, Ltd., Montreal.

Lieut. C. S. DeGruchy, M.C., formerly assistant engineer of the Halifax Ocean Terminals, who was reported as wounded, has died from his injuries, according to a cable received by his father, residing in Westmount.

First Kindergarten School

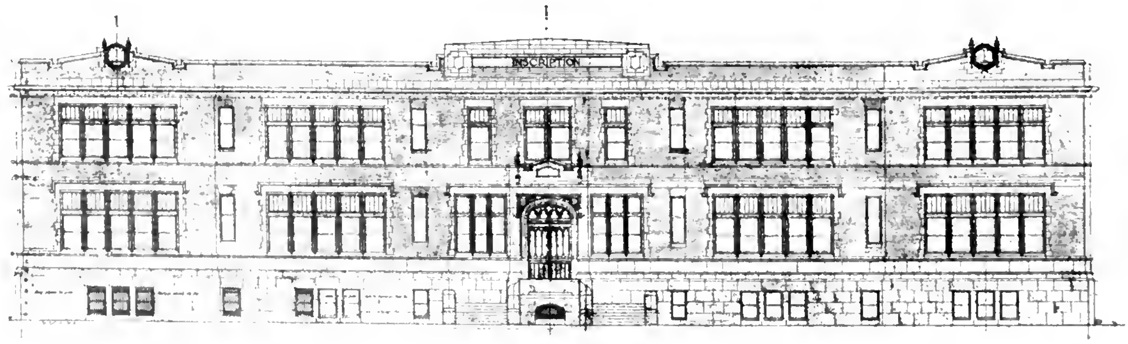
In Montreal in Course of Erection—Reinforced Concrete Skeleton—Cost Nearly a Quarter Million Dollars

A KINDERGARTEN school—the first of its kind in Montreal—is being constructed on Berri Street for the Roman Catholic school commissioners. It is known as the Ecole Maternelle St. Jean Baptiste and is designed by Bigonesse & Bigonesse, architects, of Montreal. The site is 180 x 60, with an additional 48 feet occupied by wings from the main building.

The plans show a structure consisting of a basement and two storeys. The complete skeleton of the building, including the flat slabs and supporting beams and columns, is of reinforced concrete, constructed according to the Trus-Con system. All the floors are of steel Floretyle, flat slab type, a type of reinforced concrete floors used largely in many schools, churches, and other religious institutions. The reinforcing steel and the design were supplied by the Trussed Steel Company of Canada, Ltd., Montreal.

Lightness in weight and adaptability for long-span construction are claimed for Floretyle construction, thus enabling architects to make a design without any exposed beams at the ceilings and to give flat ceilings over a large recreation hall, approximately 33 x 70 ft., and twelve large class-rooms, the smallest of which is 25 x 30 ft.

The foundations are of concrete and the exterior of



Front elevation of first kindergarten school in Montreal.

Shawnee rustic brick, with trimmings of Montreal limestone, and a base of the same material. The cornices are also of stone. St. Lawrence brick is used for the rear walls. The whole of the walls are backed with terra cotta and finished in plaster.

The school is a mixed one, and is divided into two sections by a terra cotta wall running from the front to the back. Each section—one for boys and the other for girls—is a duplicate of the other, except in one or two unessential particulars. Communication is provided, whereby the teachers can reach either section.

The basement contains accommodation for the caretaker, heating and ventilating apparatus, and a very large recreation hall, referred to above, where provision is to be made for roller skating. The two other floors contain class and recreations rooms, with large corridors running down the centre of the building. The interior partitions are of terra cotta and plaster; the ceilings are of plaster, with round edges. Each class-room is provided with cloak-room accommodation. On the ground floor there are reception-rooms and a small office. A feature of the next floor is the dormitories, fitted up for quite young children who require sleep in the middle of the day.

There are lavatories on each floor, opalite being employed for the divisions in place of marble.

Iron fire-escapes are provided at the rear, and are reached from concrete balconies at each floor, doors at either end of the building giving access to the balconies.

There is a main entrance in the centre of the building, approached by stone steps, and one at each end of the building. The stairs are of concrete, with iron and slate treads. The lighting is by electricity, while the heating is on the indirect hot water system, and the ventilation on the forced plan.

At the rear are two large playgrounds—one for boys and one for girls—divided by a brick wall. A foot of sand is provided for playing purposes.

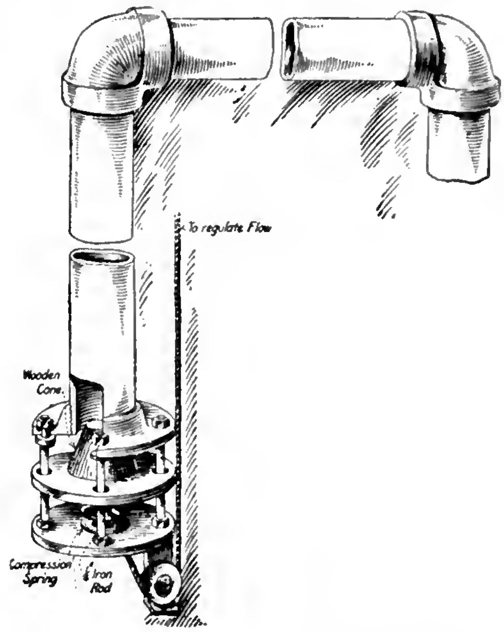
The general contractor is Mr. J. A. Durocher, Montreal, and the conract price $205,000.

Simple Valve Regulates Flow of Siphon for Draining Excavations

THE objection is sometimes raised to the use of a siphon in draining pits that it is difficult to regulate the flow so that when the pit is entirely drained the pipe will not draw air, necessitating priming it again, and this continual priming might involve more labor than the direct use of a pump. Regulation of the flow of a siphon to any degree up to the capacity of the pipe can be secured by use of a valve made as here described or modified to suit any particular conditions met with in the various uses of a siphon. The device is described by J. M. Purcell in Power.

The essential parts are shown in the illustration, and consist of three flanges fitted to the discharge end of the siphon pipe, four rods, a compression spring, a cone-shaped piece of wood, and a piece of rope. One flange is screwed to the end of the siphon pipe and connected to a second flange by the four rods, equally spaced. The cone-shaped piece of wood, which acts as the disk of a valve, seats on the third flange, which is guided by the four rods and forced to its seat by the spring. The rope can be attached to the lower end of the wooden cone and is used to pull the disk away from the mouth or the pipe, thus regulating the flow of water. The spring at all times tends to return the disk to its seat. To make a better job the cone could be covered with rubber packing.

In operation, the longer leg of the siphon is filled with water and the other end placed in the pit that is to be drained. The rope is then pulled, and the water in flowing from the pipe will draw the water from the pit, the amount of water flowing being controlled by the valve opening. To stop the siphon the rope is released, allowing the disk to return to its seat, thus entrapping



Rope operates cone valve for controlling siphon.

the water in the long leg, until it is desired to start the siphon again. This means is preferable to the common practice of throttling the intake.

C.S.C.E. President Recruiting

Lieut.-Col. J. S. Dennis, the president of the Canadian Society of Civil Engineers, is taking a very active part in the British recruiting mission in the United States. He is in charge of the western division, with headquarters at Chicago. Lieut.-Col. Dennis also had charge of the program of the Canadian Highlanders' campaign in that city. At a dinner given in New York in connection with the recruiting he strongly objected to the presence of two German waiters, who were removed at his request.

Engineer Wins M. C.

Captain Joseph A. LeRoyer, civil engineer, formerly of Montreal, has been awarded the Military Cross. He originally joined the 163rd Battalion, Montreal, and was then transferred to the Royal Flying Corps. The official announcement states that Captain LeRoyer had shown great skill and courage while acting as observer, and had by his accurate shooting and coolness under fire contributed much to the success of several aerial fights with the enemy.

The Catholic School Commission of Montreal have awarded the contract for supplying all the reinforcing steel for the Ecole St. Nom de Marie, Maisonneuve, to Mr. G. B. Reynolds, engineer and sales agent for the Trussed Concrete Steel Company of Canada, Ltd., Montreal.

Dry Rot—Its Causes and Prevention

In Paper Read at Institution of Municipal and County Engineers Author Suggests Measures to Secure Immunity from Disease

By E. J. Goodacre, A. M. Inst., C. E.

THE prevalence of dry rot in this country is caused by the growth of fungi, which are responsible for the rotting and eventual destruction of structural timbers in buildings, etc. Dry rot fungi are of domestic growth, and are not found in living trees, but the disease may possibly originate when the trees lay fallen in the forest.

There are known at present to be three different species of fungus causing dry rot, viz., Merulius lacrymans, Coniophora cerebella, Polyporus vaporarius. The following is a short description of the respective fungi which are, however, seldom found in existence as isolated specimens:

Merulius lacrymans derives the former part of its name from Merula (black bird), due to its eventual discoloration, and the latter part being appropriate because of the "tears" often observable in conjunction with it.

Clay Subsoils Aid Growth

This is the most malignant form of dry rot; it thrives in moderate climates and over clayey subsoils —this is important in drafting building by-laws in such districts for the prevention of dry rot. When once established it will develop and destroy the driest timbers, owing to the property which it possesses of producing its own "tears" or moisture.

Infection of wood is due to spores, which are produced in large dark-brown rust-like undulating patches with white margins ,and are known as fructifications, which, when facing upwards on horizontal supports are usually sterile, and fertile when facing downwards. The spores of Merulius when kept dry, retain their vitality for many months, which thus increases the infectiousness of the disease.

Spores are also formed on the hyphae, which are long, slender, tube-like formations, which weave themselves into strands or cushions, known as the mycelium. This characteristic is very important, as it is prima facie evidence of dry rot. These fungal cords possess great powers of resisting drought, and enables the fungi to spread very rapidly over innutritious surfaces, such as glass, brick walls, mortar joints, and iron pipes, for considerable distances to other woodwork.

Alkali Not Essential

The old idea that Merulius lacrymans requires an alkali such as ammoniacal exhalations—to promote the development, has, according to later research, proved to be erroneous. Merulius is capable of destroying the sapwood and heartwood of most woods, especially coniferous timbers. Hardwoods are not immune from the malady.

Coniophora cerebella is very similar in appearance to Merulius, in conjunction with which it is so often found. Moisture is absolutely essential for the growth of Coniophora. Absolute dryness, therefore is a direct safeguard against this fungi, and, of course, indirectly against Merulius lacrymans. The mycelium of Coniophora is in the form of slender black threads in great profusion.

Polyporus vaporarius (often known as "red rot").—The fructifications of this variety are white, and easily distinguished from those of Merulius. The fungal cords of Polyporus differ from the hyphae of Merulius, for they become very tough in the former case, instead of brittle when dry and old, as in the latter case. Polyporus causes the red decayed patches in deal.

Infection the Cause of Dry Rot

The cause of dry rot is directly attributable to infection—chiefly by direct contact—accompanied by conditions favorable to the germination of the spore. The spores are microscopic in size. It is computed that there are 9,000,000 spores to a square inch, therefore on an average-sized plant there are, roughly, 100,000,000 spores, each capable of much harm; and their small, brown, dust-like nature enables them to float a long distance in the air before settling. Should this resting-place prove to be congenial to its growth, then infection is assured.

The conditions required for fertility are moisture and moderate temperature. The rate of decay is dependent upon the relative humidity—the ratio of the amount of moisture to saturation point at a given temperature (10 to 20 degrees Cent.)

Moisture is, therefore, essential to the activity of dry rot fungi in a greater or lesser degree, according to the species; but it must be noted that the degree is fairly constant to the respective fungus. For instance, Coniophora demands a good deal of moisture, and is most frequently found in cellars. So great is the affinity which this fungi has for moisture that its growth is prima facie evidence of a damp building; it is often found growing on a rafter under a leaky roof. On the other hand, Merulius and Polyporus, when once established, can grow on the driest wood, depending on their own power for the production of moisture. This fact renders Merulius, which possesses this function to a much greater degree than Polyporus, the most insidious source of dry rot.

Chemical analysis of rotted wood shows that it contains relatively less hydrogen than carbon than the sound wood. This would appear to indicate that moisture is produced by oxidation. Authorities differ as to whether these fungi can be grown in water.

Temperature affects the fungi, causing dry rot. Merulius lacrymans thrives at a moderate temperature. The mycelia are rapidly killed by exposure to a temperature of 40 degrees Cent.; so that infected wood can be easily sterilized by heat that does not burn the timber. Spores and the fungi themselves are quickly killed by steam, but the resistance to lower temperatures is greater, and frost does not affect it.

Dry rot progresses much faster in summer than in winter in an ordinary building which is heated, and thus has its air made relatively dry during the winter months.

Determining the Extent of Rotting

In examining a building affected by dry rot the fungi should be carefully and minutely examined with a view to identifying the species. The extent of the rotting can generally be estimated approximately by boring test holes in the timber at frequent intervals. If the material is badly rotted the borings brought out will be in the form of brown powder. Hammering on the timber with a hammer is another method frequently adopted, a dull sound denoting probable rotting internally. The presence of dry rot fungi can often be detected by the familiar unpleasant odor.

The first obvious preventive measure is to guard against contact with infected wood, including spores. Fungi are frequently carried in lumber and spread by placing it in large piles with scant ventilation. This, no doubt, accounts for the fact that original infection of timber in the majority of cases is contracted in the timber yard of builder's stores. Lack of sanitation and bad methods of stacking sawn wood aggravate the disease. It would appear advisable that the whole of a timber yard should be well paved in tar-macadam and thoroughly drained.

Remove Conditions Favorable to Growth

The next means of prevention is to deprive the fungi of the conditions favorable to growth. In the first place, then, the timber should be thoroughly dry and well seasoned—in fact, it would be well to have all timber, such as floor joists, etc., dessicated or "stoved" to a temperature of 50-60 degrees Cent. The seasoning is rendered more important nowadays owing to the amount of timber felled before maturity. The timber should be protected from wet during building operations, and afterwards protected by adequate ventilation and suitable methods of construction.

To secure these measures then, in practice the following methods should be adopted to prevent the development of Coniophora cerebella, that require definitely moist wood, and also to decrease the susceptibility of the timber to Merulins.

The wood should be brought direct on to the job and placed under cover; the floor joists, especially the ground-floor joists, should be creosoted; the objection to the smell of this treatment, of course, is against it, but it is more apparent than real, especially after some months' exposure.

All vegetable earth should be removed from under floors, as ammoniacal exhalations are certainly favorable—though not essential—to the growth of the fungi causing dry rot.

The building site should be covered with at least 4 inches of cement concrete asphalted on the upper surface. This, however, is an expensive method, and it is suggested that 4 inches of tar-macadam would be a very effective substitute.

Ventilation Under Floors

The ventilation underneath floors should be carefully designed, because if it is not thorough it will do more harm than good. For instance, you will possibly be supplying moisture and oxygen—two essentials to the growth of fungi. The best method, therefore, is to fix fresh-air inlets on all sides of the under floor space, with an extraction flue taken up the chimney breast alongside the smoke flues. Should there be a solid floor adjacent to any side of an open floor, through currents of air should be ensured by laying ducts through the solid floors.

The ends of all joists should be fixed in such a manner that there is a passage of air all round the end of the joist as far as possible. A good method of attaining this is to let the joists take a bearing on a 2-in. by ½-in. flat bar of iron laid on the supporting wall.

Pugging should be avoided in floors.

Immunity from dry rot is encouraged by laying the concrete, etc., under the floors at any early stage of the erection and delaying the laying of floors until the latest possible moment, when the house is comparatively dry. Needless to say, the floorboards should be stored in a dry place before use.

Shavings Originate Rot

Care should be taken that no shavings are left under the floors by the carpenters, as this practice is frequently the origin of dry rot. In cases where boards or wood blocks are fixed directly on the concrete they should be bedded on some bitumastic compound; the concrete and the screeding also must be thoroughly dry. On no account should wooden pegs driven in the ground be used as concrete screeds.

Linoleum and other similar floor coverings aggravate the activity of the fungi causing dry rot, but floors should be so constructed as to obviate any ill effects from their use.

Skirtings and other wall mouldings should on no account be fixed until the walls are quite dry. The practice of rendering walls behind skirtings with cement is to be commended, but it must be perfectly dry before skirting is fixed.

Studded partitions should be plastered with ordinary plaster, which is somewhat porous and admits of ventilation.

Special attention should be given to dampcourses with a view to minimizing the risk of dry rot. The more extensive use of vertical dampcourses would be a step in the right direction. Horizontal dampcourses are frequently fixed only just above the ground level and just below the joist level, with the result that the bricks are continuously soaked with moisture, and, therefore, form a reservoir from which fungi may draw their "life blood." Lead, asphalt bitumastic compounds on fabric and slates in cement are all satisfactory.

Hollow Walls Recommended

Hollow walls suitably ventilated is a system of construction especially to be recommended from this standpoint. In this system the ends of floor joists should be open to and not project into the cavity. Lead and asphalt flats on a wooden sub-structure are very prone to dry rot, and where the underside of the joists are ceiled the preventive measures present difficulties. Reinforced concrete, however, has enabled us to overcome the use of timber in such cases.

It is necessary to take particular care that no timber should be painted which is immaturely seasoned or rot dry.

In dealing with cases where the presence of a serious attack of dry rot has been established more drastic action is necessary. The infected wood should be oiled to keep down the spores, and carefully removed and burned, and not deposited in a builder's yard. The carpenters' tools, especially the saw, used on the work should be sterilized. This may appear to some to be rather too stringent, but the advisability of such a precaution is undoubted. The adjoining woodwork should be carefully tested, as previously stated, and removed if there are the least signs of the fungi. The brickwork or stonework should be sterilized by a blast flame, and the woodwork should be dried (not by a gas jet, which forms moisture as a product of combustion)—and treated with a wash of dilute formalin, which is a safe and most effective antiseptic, although it must be noted that through evaporation this treatment is purely temporary. Carbolic acid is also a valuable antiseptic for this purpose.

Antiseptic Treatments

Hot limewash is very useful for a mild attack, and, in fact, most antiseptics are more or less effective.

It must, however, be strongly urged that, owing to the difficulty of completely eradicating the fungi when once established, preventive measures are of paramount importance.

In conclusion, it is necessary to say that the present knowledge of fungi causing dry rot is immature, and the results of research are often very eccentric and sometimes contradictory. The author has endeavored to compile the generally accepted results of the valuable work already accomplished by experts in this and other countries, together with a few practical suggestions.

The annual loss in this country alone through dry rot must be alarming; and, in view of the diminishing timber supplies, this also renders the subject one of extreme national importance.

Modern Sewage Purification Works—Design, Construction and Management

By Charles Terry*

IN preparing this paper upon the subject before us I wish it to be clearly understood that it is not my intention to assume the position of dictator or critic, neither do I wish to advance a new theory or attempt to lay down any dogmatic rules with the idea that they may be applied to the design of every modern sewage works. Past experience has convinced us that to attempt such a proposition must end in disappointment and failure. The varying circumstances connected with each locality render it impossible to fix any definite standard or plan of operations that could with any degree of safety be adopted by the engineers when called upon to make a design for a new works upon modern principles.

While agreeing that this is so, we as an association of managers should be prepared to acknowledge the wonderful advance that has been made in the direction of solving the great problems with which we are so deeply interested since the time the association has been in existence, and should be proud also to acknowledge that much of the advance in this direction has been due to men who, in the face of great difficulties and assailed with much adverse criticism, have gone forward and by hard work and persistent determination have brought this particular branch of sanitary science to such a position as to at least make it possible, provided certain laws are observed, to purify sewage to almost any extent, and by their labor, loyally seconded by members of this association, have raised the duty of the works manager from that of rule of thumb to that of scientific administration.

Having thus given the negative side of my intentions, I pass on to the positive, in connection with the first division of the subject, viz.:

Design

The very fact of this great advance and the increasing number of modern works being designed, largely, if not exclusively, upon the generally accepted principles known as the bacterial process, make it necessary, in the author's opinion, to emphasize a few details which from a manager's point of view are essential in the design of sewage purification works, and which I fear, in view of the success already attained, are calculated to be, if not altogether overlooked maybe by some engineers, relegated as secondary in importance and too old-fashioned to be given the attention it deserved. Therefore it is in order that up-to-date works shall have a chance of successful working that I venture to mention a few details which, if neglected, will, in the author's opinion, render it difficult, if not absolutely impossible, to administer the modern works to the best advantage. These details I propose to mention in the order in which they occur.

In the opinion of the author, in all cases the level of the water in the sump or channels should be at such a level as to allow at all times a free discharge, the reason being, in the first place, this will prevent the deposit of grit in the sewer, and, secondly—from a manager's point of view this is of great importance—the prevention of the crude sewage from undergoing that objectionable and I trust out-of-date process known as septic action, the effect of which renders the liquefied sewage far more difficult to treat by any of the known processes. Having by this means prevented the accumulation of grit in the sewer, provision should be made as soon as possible to arrest it. This can be readily done by forming a small grit chamber in the sump or channel, to which an elevator should be connected. If this is mechanically operated and kept in continual motion it will be found effectually to prevent any accumulation of grit, and will give little trouble.

Screen

If found necessary to pump the crude sewage into the tanks a screen is absolutely necessary. Many screens used to-day are of very elaborate construction, and altogether unnecessary in many cases. If at a high level, and within easy reach from ground level, there is nothing which gives so little trouble as a simple inclined grating, with bars close enough to prevent sticks or large rags, or anything calculated to injure the pump, from passing, but wide enough to allow all paper and excrement to pass through freely. If found practicable to use such a screen it can be kept clean by the use of a rake by hand, but if at a low level it will be necessary to provide a cleaning rake, mechanically operated, and again kept in continual motion.

Pumps

The great variety of pumps used and their efficiency being so well known renders it unnecessary for me to detain you upon that particular detail. But I should like to say one word as to the power used to operate them. I am well aware that this has very largely to be governed by the locality in which the works are situated. But if in such a position that will enable the engineer to obtain current direct from the local mains,

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and providing it can be had at a reasonable figure, I am convinced there is nothing to compare with electricity, either for convenience, efficiency, or economy, providing always the pumps are arranged upon the step-up principle, by which I mean one pump capable of lifting up to half the maximum hourly flow and one from half to the maximum.

By adopting this plan at the works of which I have charge a net saving of $10 per week was effected on the night flow only. The reason, I think, is obvious—that a pump electrically driven is working at its highest point of efficiency when under full load. This principle can be applied either with a small or a large hourly flow. I think I am justified in asserting that practically all engineers, and certainly a large majority of managers, agree that the final purification of sewage, if not at present, in the very near future, will be accomplished by the bacterial process, either by the use of contact beds or percolating filters, being by experience assured that under proper conditions and with properly-designed works this can be done in such a manner as will reflect the greatest credit to the engineer and manager.

It is with one of the conditions I now wish to engage your consideration, conscious at the outset that I shall have to part ways with many who to this point have been in agreement with what I have written. However, if we differ, I feel sure we shall do so prompted with but one desire, viz., the general good of the object we have in view.

One rule or condition laid down by all experts is that if a contact bed or filter is to work efficiently for any length of time it is absolutely necessary that the maximum quantity of suspended solids must be extracted previous to its final application to the filter or bed. It has been given by many experts that no more than ten parts per 100,000 of suspended solids should be put upon such filters or trouble will be the obvious result. But with the exact quantity we will not quarrel. What concerns us as managers is the principle, which, after all, is but common sense; and, while we are glad to acknowledge that the difficulties of the final purification of the liquid sewage have to a large measure been overcome, we as managers are convinced that the difficulty connected with our old friend Sludge is increased to a considerable extent. It is with the object of keeping this side of the question before those who are called upon to design new works that I venture to suggest that they, assisted by the members of this association, should give of their best to try and bring about as satisfactory a solution in this connection as has been done with the final treatment of the liquid sewage.

Design of Tanks

To accomplish this, I beg to suggest that the one idea in the design of tanks should be not to change or destroy, but to arrest the solids, letting the amount of solid matter arrested be to some degree a visible evidence of the purification effected.

This, in the opinion of the author, can be readily done without the aid of expensive, complicated tanks, although some of these are doing good work. But during twenty-five years' experience with a fairly strong domestic sewage, I have found that if the tanks are so arranged that the direction of the flow is changed in each tank, it will be found that there will be no difficulty in getting the solids to fall to the floor, and the maximum quantity of solids will be arrested in the minimum amount of time. Such tanks being provided with good, but simple, means of cleansing, will be found to operate efficiently and give the least amount of trouble to the manager or his assistants. Having thus arrested this objectionable but necessary evil, it follows that some means of disposing of it is necessary. This brings us to a subject which I submit has not had the consideration which is due, but one which demands thoughtful attention before our modern works can be regarded as satisfactory. I therefore submit that the expert, be he engineer or manager, who can design a plant which can be relied upon at all seasons to render the sludge as collected from the tanks capable of being transported, either by road or rail, will have accomplished a task which, added to the improvements already effected, will have done much toward the complete solution of this difficult problem, in the solution of which we are all more or less engaged. I am aware that chemists tell us there is little or no manurial value in this product, but, as the proof of the pudding is in the eating, so the proof of the value of sludge in its natural state is manifestly proved in the satisfactory crops resulting from the use of it. Therefore, I have long since come to the conclusion that the proper place for the solid matter collected at the sewage works is "the land." And at such times as these, and in view of the requirements of the future, it behoves us to spare no effort to prevent the waste of anything that may by the help of nature enrich the soil, from which it is necessary to obtain every ounce of food possible.

Filters

Little can be said as to the design of filters or contact beds. Each case must be determined by the particular circumstances surrounding the position of the works; but again I ask all engineers who are putting down works upon the bacterial principle to make liberal provision for humus, which is a glorified name for sludge, for be assured that this humus or sludge will accumulate in proportion as the filters do their work.

Construction

Upon this aspect of the subject I do not think I need detain you for long, there being comparatively few points upon which we should be found to differ. But I suggest that it is very noticeable that at some works, constructed upon the modern principle, nothing has been spared to render the construction of buildings, tanks, filters, etc., not only substantial, but in some cases extravagance is apparent in almost everything. I am afraid in such cases the object in view has been percentage rather than efficiency, and obviously without regard to the source from which the finance emanated, viz., the ratepayers.

In the construction of new works it is the opinion of the author that, where practicable, it will be found an advantage to carry out such work by direct labor, under the supervision of the engineer, the manager acting as his clerk of works. In making this statement it is not my intention to suggest anything detrimental to contractors, many of whom take a delight in carrying out the work entrusted to them in a very satisfactory manner, but I feel convinced by adopting the suggestion of direct labor the manager becomes intimately acquainted with many hidden details which would otherwise escape his notice. Again, oftentimes the engineer finds it to his advantage to use material which would otherwise have to be disposed of at a very low price, but which, if used, would be worth as much as the best material.

In this connection I venture to suggest that with proper care and judgment nearly the whole structural part of the works may be substantially, efficiently, and economically constructed by the use of the fine ash screened from the clinkers used for filling the filters, and, if used in proper proportions with Portland cement, will give every satisfaction as regards appearance and stability.

In conjunction with the city engineer, the author has recently erected eleven 80-foot diameter percolating filters, the floors and retaining walls of which have been constructed with this material, the results of which are very satisfactory indeed. The cost, including all necessary timber, etc., for forming walls, was 15s. per yard cube.

It may be rightly argued that retaining walls are not necessary, and that large clinkers or stone blocks can be used, as is the case in many works. With that I quite agree, but in the case before us it was impossible to obtain large clinkers or other large material in the district; therefore, by using the fine ash screened from the clinkers, with cement in the proportion of five to one, a good and substantial job was made, which, I venture to say, did not cost more than the dry building of large material had these been used.

Another rather expensive item generally met with in constructing contact or percolating filters is that of drainage floor tiles. Again the fine ash can be brought into good use in providing for this. The author has designed and registered a floor tile for this purpose which he is confident will in every respect answer as well as any one of the most expensive glazed tiles upon the market to-day and they have the advantage in most cases of being much cheaper. The cost, allowing for the use of clean sand and cement, is at the rate of 2s. per square yard. One great advantage of using tiles such as these is that, being manufactured on the site, there is a considerable saving of haulage by road and rail. By the use of this tile at the works already mentioned, the author was enabled to effect a saving on this item alone of $1,500. In addition there is the advantage of a new industry in connection with the destructor works, by which means much which is now considered waste material can be turned into commercial value.

In the construction of manholes, valve pits, tank walls and floors I am convinced nothing that can be used for this purpose will give better results and be more easily worked. Any good, intelligent workman, with a little practice, can do all that is needed to effect a good job.

This brings me to my last division, viz., management.

Management

This, being the last, is by no means the least item of importance in connection with our subject. For, although we may, and doubtless shall, differ in our opinions regarding both the design and construction, I am convinced we shall all agree that, no matter how perfect the design and generous the provision made for the sludge disposal or filtration of effluent, no matter how elaborate and substantial the construction, if badly and carelessly managed, failure is bound to be the result. I cannot hope to be able to teach my hearers, many of whom have spent many years of their life in this particular branch of sanitary work, who have proved themselves efficient and valuable officers. The works of which they have charge are a credit to the councils by whom they are engaged, owing to the faithful and conscientious manner with which they have discharged their duties.

I am afraid that there is a possibility of the services of this particular officer often being overlooked by the powers that be; not because the authority wishes to slight him, but more often because of a want of real knowledge on the part of the committee or council as to the importance of the work which the manager is called upon to do. That is the only reason which has brought some of our members in the past to seek by some means to raise the status of the managers and prevail upon the authorities by whom they are engaged to see to it that they have a chance, with other officials, of receiving the appreciation of the authority, which is due to them by virtue of the office they fill. To bring this about in a way which the author firmly believes would be acceptable to all concerned I suggest that the man appointed to take charge of what I confidently assert to be one of the most delicate pieces of machinery, upon proving his qualifications, should be appointed by and be responsible to the committee or council, and should have given him the absolute and complete control of every department of the works. By this means he would be brought in touch with his employers from time to time, who would be bound to acknowledge him in his true position, viz., an official of the corporation or board.

Lyman Tube and Supply Company Occupy New Building

The advantages of premises designed and built, especially to meet their needs are greatly facilitating the work of the Lyman Tube and Supply Company, Ltd., in their new home in the Lyman Tube Building, 10 St. Sophie Lane, Montreal. In this new fireproof building of reinforced concrete they have ample room, exceptionally good lighting, and a location convenient to the three transcontinental railway stations and to the business section of Montreal. Realizing that the rapid growth of the company's business would soon overflow the space available in their St. James Street premises, Mr. Frank D. Lyman, the managing director, arranged last fall for the erection of a five-storey-and-basement building of the most modern fireproof type, suited for warehouse and light manufacturing purposes. This is now completed, moving is over, and the company are taking full advantage of the improved facilities. Not only have facilities been greatly improved, but the personnel of the company is being steadily strengthened. Mr. C. P. Lyman, brother of the managing director, who since the organization of the company has been its secretary-treasurer, having from the first of the year been actively connected with the business.

The Canada Stove and Foundry Company, Ltd., Ville St. Laurent, Montreal, have recently built a large enamelling plant for the purpose of enamelling steel and cast iron stoves, ranges, etc., and will also in the very near future have a full line of cast iron hollow ware, druggists' enamelled sundries, etc., to offer for sale. The special grade of enamel the company are using is adapted for chemical work and is warranted to resist any acid. Among the articles manufactured are enamelled ice cream containers in sizes ranging from one to forty quarts.

Pettypieces Limited, Amherstburg, Ont., have just received a contract for 2,000 feet of 12-inch crock sewer at $2.25 a foot.

Concrete Forms and Construction Details

As Specified by the Joint Committee—Continuation from Last Issue of Recommendations for Concrete

FORMS

Forms should be substantial and unyielding, in order that the concrete may conform to the design and be sufficiently tight to prevent the leakage of mortar.

It is vitally important to allow sufficient time for the proper hardening of the concrete, which should be determined by careful inspection before the forms are removed.

Many conditions affect the hardening of concrete, and the proper time for the removal of the forms should be determined by some competent and responsible person.

It may be stated in a general way that forms should remain in place longer for reinforced concrete than is required for plain or massive concrete, and longer for horizontal than is required for vertical members.

In general it may be considered that concrete has hardened sufficiently when it has a distinctive ring under the blow of a hammer, but the test is not reliable if there is a possibility that the concrete is frozen.

DETAILS OF CONSTRUCTION

1. Joints

(a) In Concrete.—It is desirable to cast an entire structure at one operation, but as this is not always possible, especially in large structures, it is necessary to stop the work at some convenient point. This should be selected so that the resulting joint may have the least possible effect on the strength of the structure. It is, therefore, recommended that the joint in columns be made flush with the lower side of the girders, or in flat slab construction at the bottom of the flare of the column head; that the joints in girders be at a point midway between supports, unless a beam intersect a girder at this point, in which case the joint should be offset a distance equal to twice the width of the beam; and that the joints in the members of a floor system should, in general, be made at or near the centre of the span.

Joints in columns should be perpendicular to the axis, and in girders, beams, and floor slabs perpendicular to the plane of their surfaces. When it is necessary to provide for shear at right angles to the axis, it is permissible to incline the plane of the joint as much as 30 degrees from the perpendicular. Joints in arch rings should be on planes as nearly radial as practicable.

Before placing the concrete on top of a freshly-poured column a period of at least two hours should be allowed for the settlement and shrinkage.

Shrinkage and Contraction Joints

Shrinkage and contraction joints may be necessary to concentrate cracks due to temperature in smooth, even lines. The number of these joints which should be determined and provided for in the design will depend on the range of temperature to which the concrete will be subjected, and on the amount and position of the reinforcement. In massive work, such as retaining walls, abutments, etc., built without reinforcement, contraction joints should be provided, at intervals of from 25 to 50 ft., and with reinforcement from 50 to 80 ft.; the smaller the height and thickness the closer the spacing. The joints should be tongued and grooved to maintain the alignment in case of unequal settlement. A groove may be formed in the surface as a finish to vertical joints.

Shrinkage and contraction joints should be lubricated by an application of petroleum oil, or a similar material, to permit a free movement when the concrete expands or contracts.

The movement of the joint due to expansion and contraction may be facilitated by the insertion of a sheet of copper, zinc, or even tarred paper.

Lapping Reinforcement Bars

(b) In Reinforcement.—Wherever it is necessary to splice tension reinforcement the length of lap should be determined on the basis of the safe bond stress, the stress in the bar and the shearing resistance of the concrete at the point of splice; or a connection should be made between the bars of sufficient strength to carry the stress. Splices at points of maximum stress in tension should be avoided. In columns, bars more than ¾ in. in diameter not subject to tension should have their ends properly squared and butted together in suitable sleeves; smaller bars may be lapped as indicated for tension reinforcement. At foundations bearing plates should be provided for supporting the bars, or the bars may be carried into the footing a sufficient distance to transmit the stress in the steel to the concrete by means of the bearing and the bond resistance. In no case should reliance be placed upon the end bearing of bars on concrete.

2. Shrinkage and Temperature Changes

The stresses resulting from shrinkage due to hardening and contraction from temperature changes are important in monolithic construction, and unless cared for in the design will produce objectionable cracks. Cracks cannot be entirely prevented, but the effects can be minimized.

Large cracks, produced by quick hardening or wide ranges of temperature, can be broken up to some extent into small cracks by placing reinforcement in the concrete; in long, continuous lengths of concrete it is better to provide shrinkage joints at points in the structure where they will do little or no harm. Reinforcement permits longer distances between shrinkage joints than when no reinforcement is used.

Provision for shrinkage should be made where small or thin masses are joined to larger or thicker masses. At such places the use of fillets similar to those used in metal castings, but proportionally larger, is recommended.

Shrinkage cracks are likely to occur at points where fresh concrete is joined to that which is set, and hence in placing the concrete, construction joints should be made, as described in Section 1, or, if possible, at points where joints would naturally occur in dimension stone masonry.

3. Fireproofing

Concrete, because incombustible and of a low rate of heat conductivity, is highly efficient and admirably adapted for fireproofing purposes. This has been demonstrated by experience and tests.

The dehydration of concrete probably begins at about 500 degrees F. and is completed at about 900 degrees F., but experience indicates that the volatilization of the water absorbs heat from the surrounding mass, which, together with the resistance of the air cells, tends to increase the heat resistance of the concrete, so that the process of dehydration is very much retarded. The concrete that is actually affected by fire and remains in position affords protection to that beneath it.

The thickness of the protective coating should be governed by the intensity and duration of a possible fire and the rate of heat conductivity of the concrete. The question of the rate of heat conductivity of concrete is one which requires further study and investigation before a definite rate for different classes of concrete can be fully established. However, for ordinary conditions it is recommended that the metal be protected by a minimum of 2 in. of concrete on girders and columns, 1½ in. on beams, and 1 in. on floor slabs.

Where fireproofing is required and not otherwise provided in monolithic concrete columns, it is recommended that the concrete to a depth of 1½ in. be considered as protective covering and not included in the effective section.

The corners of columns, girders, and beams should be beveled or rounded, as a sharp corner is more seriously affected by fire than a round one; experience shows that round columns are more fire-resistive than square.

4. Waterproofing

Many expedients have been resorted to for rendering concrete impervious to water. Experience shows, however, that when mortar or concrete is proportioned to obtain the greatest practicable density and is mixed to the proper consistency the resulting mortar or concrete is impervious under moderate pressure.

On the other hand, concrete of dry consistency is more or less pervious to water, and, though compounds of various kinds have been mixed with the concrete or applied as a wash to the surface, in an effort to offset this defect, these expedients have generally been disappointing, for the reason that many of these compounds have at best but temporary value, and in time lose their power of imparting impermeability to the concrete.

In the case of subways, long retaining walls, and reservoirs, provided the concrete itself is impervious, cracks may be so reduced by horizontal and vertical reinforcement properly proportioned and localized that they will be too minute to permit leakage, or will be closed by infiltration of silt.

Asphaltic or coal-tar preparations, applied either as a mastic or as a coating on felt or cloth fabric, are used for waterproofing, and should be proof against injury by liquids or gases.

For retaining and similar walls in direct contact with the earth the application of one or two coatings of hot coal-tar pitch, following a painting with a thin wash of coal-tar dissolved in benzol, to the thoroughly dried surface of concrete, is an efficient method of preventing the penetration of moisture from the earth.

5. Surface Finish

Concrete is a material of an individual type, and should be used without effort at imitation of other building materials. One of the important problems connected with its use is the character of the finish of exposed surfaces. The desired finish should be determined before the concrete is placed, and the work conducted so as to facilitate securing it. The natural surface of the concrete in most structures is unobjectionable, but in others the marks of the forms and the flat, dead surface are displeasing, making some special treatment desirable. A treatment of the surface which removes the film of cement and brings the aggregates of the concrete into relief, either by scrubbing with brushes and water before it is hard or by tooling it after it is hard, is frequently used to erase the form markings and break the monotonous appearance of the surface. Besides being more pleasing in immediate appearance such a surface is less subject to discoloration and hair-cracking than is a surface composed of the cement that segregates against the forms, or one that is made by applying a cement wash. The aggregates can also be exposed by washing with hydrochloric acid diluted with from 6 to 10 parts of water. The plastering of surfaces should be avoided, for, even if carefully done, it is liable to peel off under the action of frost or temperature changes.

Various effects in texture and in color can be obtained when the surface is to be scrubbed or tooled by using aggregates of the desired size and color. For a fine-grained texture a granolithic surface mixture can be made and placed against the face forms to a thickness of about 1 in. as the placing of the body of the concrete proceeds.

A smooth, even surface without form marks can be secured by the use of plastered forms, which in structures having many duplications of members can be used repeatedly. These are made in panels of expanded metal or wire mesh, coated with plaster, and the joints made at edges, and closed with plaster of Paris.

(To be continued)

Two Baby Hoists Run a Disabled Derrick

TWO little tugger portable air hoists were substituted recently for the regular swinging gear used to operate a large quarry derrick in Vermont while the regular engine was being repaired. The arrangement is outlined by H. L. Hicks in the Compressed Air Magazine. As the derrick—the largest of those in use—was important to continuous operation, the quarry was practically tied up by an accident to its swinger. The superintendent, however, quickly improvised a new swinging gear by bolting the two "little tuggers" side by side to 2-in. planks, which in turn were chained to two large blocks of granite. The line from the hoists were led to opposite sides of the bullwheel, one being used to turn the derrick in one direction and the other to swing it back. This improvised arrangement kept the derrick in operation more than a week while the regular swinging engine was being repaired. In ordinary service one of these little hoists is used to overhaul the heavy cable from one of the derricks across the quarry pit, while the other is used in lowering steels and light loads into the pits.

The Municipal Handbook of the City of Toronto for the year 1917, compiled by City Clerk W. A. Littlejohn, is now ready for distribution. This handbook contains a quantity of interesting information about the city government in general. This year it is very handsomely bound in red morocco, with gilt edges, and contains 140 pages.

How a College or University Can Help Municipal Engineering Services

By Prof. Arthur H. Blanchard, M. Can Soc. C.E.*

THE opportunities of institutions with well-manned and thoroughly equipped engineering departments to be of service to municipalities are many and varied. While not presupposing that the following suggestions cover the entire field of service which might be rendered, the concrete recommendations will serve to illustrate the nature of the relationships which are practicable.

Fundamental Principles

In order to be of maximum service the functional activities of the institution should comply with certain fundamental principles.

First, the institution must be administered by a president, trustees, and deans sufficiently broad-minded to allow of the efficient use of its faculty and equipment in the service of municipalities.

Second, maturity, earnestness of purpose and ability to meet essential requirements should be the criterion upon which is based the utilization of the institution's facilities by members of the engineering department of a municipality and other citizens of the municipality and nearby localities who are interested in engineering work.

Third, the maintenance of a professional status which would place the rendering of consulting service by members of the engineering faculty and the conduct of laboratory tests and investigations upon the same financial basis as adopted by private practitioners.

Ways of Rendering Service

A summary of the fields of co-operation in connection with which institutions may render service to the engineering divisions of municipalities include the following:

1. Day and night courses, covering subjects of value and interest to members of the engineering division.
2. Consulting services, by members of the faculty, to the various departments of the municipality.
3. Membership of members of the engineering faculty on public service committees and commissions and in local associations.
4. Investigations and tests for the municipality, conducted in the laboratories of the institution.
5. Series of lectures in the various branches of engineering delivered by specialists.
6. The efficient utilization of the libraries of an institution by members of the municipal service.

Night and Day Courses for Municipal Employees

In order that courses given by institutions in the interest of engineering departments of municipalities should be successful, certain fundamental principles must be recognized.

First, courses must be given for which there is a demand.

Second, the courses must be conducted by men capable of efficiently instructing municipal employees and who have a reputation and experience of such a character as will attract members of the engineering division of a municipality. For example, an instructor might successfully give a course in mechanical drawing, while, on the other hand, a professor, with extended experience in practice, should give such courses as power plant design, highway engineering, water supply, etc.

Third, courses must be given at such times and in such periods as will render practicable the taking of courses by the maximum number of municipal employees. For example, night courses should be given in periods of from two to three hours on one or two evenings per week during the late fall, winter, and early spring. Day courses should be given in concentrated periods of not more than two to three weeks in length, the lectures and laboratory work requiring, on every week day, from two to eight hours per day, depending upon the character of the course. Day courses, likewise, should be given in those periods of the year in which it is practicable for municipal employees to secure leaves of absence or vacations.

Entrance Requirements and Fees

Fourth, the requirements for entrance on courses should be maturity, which has been defined in certain cases as graduation from high school and being over 21 years of age, and ability to meet the educational prerequisites of the course which the applicant desires to take.

Fifth, fees should be as low as practicable, but should cover the cost of giving the course, except in cases where public-spirited citizens, interested in the development of the maximum efficiency of municipal employees, donate funds to cover the expenses of giving such courses. In the latter case it is advisable to charge a nominal fee of from five to ten dollars, dependent upon the character and length of the course, in order to limit the attendance to students of serious purpose. Members of the faculty should be paid for giving such courses, in addition to salaries received for regular institutional instruction.

Consulting Work by Members of the Faculty

Many opportunities exist in municipalities for members of the teaching staff to establish professional relationships with municipal engineering departments which will result in mutual benefit to the municipality, the institution, and members of the faculty. Generally speaking, this work should be in the nature of consulting services, which may be temporary or on a yearly retaining basis. Charges for such work should be not less than for regular professional services, ranging from fifty to one hundred dollars per day.

Engineering Faculty on Public Service Committees and Commissions and in Local Associations

In most municipalities opportunities exist for the rendering of public service, without remuneration, as members of committees or commissions appointed by the mayor, or some other public official, or which may have been organized by a group of citizens interested in some form of public improvement. Also there may exist engineering associations or local bodies, such as chambers of commerce, whose work may be materially

*Before the Society for the Promotion of Engineering Education.

benefited by the advice of members of the engineering faculty. In the interest of the general uplift work in a community and the efficient administration of public works, membership should be accepted and, as far as practicable, enthusiastic service should be rendered. It has been the writer's experience that the plans of municipal officials and legislative bodies have been materially affected and, in some cases, directed by resolutions eminating from local committees and associations.

Investigations and Tests for Municipalities Conducted in the Laboratories of Institutions

A field of co-operative service exists, in connection with laboratory investigations and tests, which should be developed to the fullest extent. It is practicable, in many cases, to work out an arrangement which is efficient and economical both for the institution and the municipality. In most cities, due to the fact that investigations and tests are not called for in amounts requiring the continuous service of a laboratory, costs of investigations and tests to the municipality in all probability will be lower if done in an institution than if a laboratory were maintained and operated by the municipality. Furthermore, the municipality saves the capital investment. Based on an extended experience with this kind of work, it is believed that the following factors are essential to an amicable arrangement between the laboratory and the municipality.

First, the work must be conducted in accordance with the standards and methods adopted by the municipality.

Second, the work must not be done by inexperienced undergraduates or by seniors as thesis work, but the detailed work of investigations and tests must be handled by trained laboratory assistants, under the general direction of an engineer of considerable experience in practice.

Third, the name of the institution should not appear in the transaction, but it should be made through the medium of the engineer in charge of the laboratory. The engineer should contract, independent of the institution, for investigations and tests; should receive all fees for such work, and pay all expenses of conducting the work, including charges by the institution for the use of the laboratory and its equipment. This arrangement is advocated because several institutions have been unfavorably brought into the public eye through the medium of litigations in connection with which investigations and tests made in the laboratories of the institutions have been quoted.

Series of Engineering Lectures

The rendering of material educational assistance to the community may be accomplished through the medium of lectures, open to the public. These lectures may form a part of some of the regular educational programs of the institution, or may be given specifically as a part of an educational campaign in the interest of the citizens of the municipality. Such lectures should be given by recognized specialists either in the employ of the institution or who are brought to the institution from outside sources. At first glance the proposition to admit the public to lectures on special engineering subjects which form a part of the curriculum may be open to serious objection. Based on an experience of over five years in connection with this detail, the writer wishes to state emphatically that the advantages accruing from the admission of engineers and others who may be interested in the subject of the lecture far outweigh any apparent disadvantages. For example, in connection with the graduate course in highway engineering at Columbia University, from twenty to twenty-five lectures by recognized specialists were given each year. Notices of these lectures were mailed to all engineers and others in the city and nearby localities who might be interested. Attendance at such lectures was required of highway engineering students enrolled in courses in connection with which the lectures were given. At the conclusion of each lecture opportunity was given for a full discussion of the subject presented. These discussions were participated in by the highway engineering students and by engineers, chemists, and others from the outside. It is obvious that the students of the institution materially benefited by the discussions of outsiders who, in many cases, were specialists in the subject. The lectures heretofore mentioned have been on subjects in special fields of engineering. From time to time, however, the institution may do valuable work by conducting a series of popular lectures on engineering subjects primarily designed to give the public information relative to the scope of each field of engineering and works of magnitude and importance which have been accomplished in each branch.

The Efficient Utilization of Engineering Libraries

The libraries of engineering departments of an institution should be thrown open to the public, under such regulations as the necessities of each department or institution dictate. An investigation of technical libraries made at the time of the establishment of the Davis Library of Highway Engineering, now maintained by the National Highways Association at Columbia University, indicated that few engineering libraries were conducted efficiently. It is admitted that, in some cases, inefficiency is due primarily to lack of sufficient funds for proper upkeep. But in many cases practicable methods of fully utilizing the resources of a library are either not known or their value is not recognized. An individual seeking information in a definite field of engineering in entering most libraries is in the position of the searcher for the proverbial needle in the haystack. In most cases he is turned loose in the Dewey classification of literature, which is not adapted to the needs of an engineering library. In the conduct of an engineering library for the use of engineering students, as well as the public, numerous classifications and indexes of the contents of the library are essential. In the Davis Library of Highway Engineering, for example, it has been found that to properly place at the disposal of users the large mass of literature in the form of monographs, reports, specifications, etc., three indexes are necessary, namely, an author index, a title index, and a subject index. In the case of the highway engineering literature contained in eighty periodicals, currently received, a subject index has proved satisfactory.

In addition to the classes of literature already mentioned and books covering engineering and related subjects, an engineering library should contain a series of files of catalogues of materials and equipment used in the branches of engineering covered by the library. In the Davis Library of Highway Engineering these files have proved of inestimable value to engineers, chemists, and contractors. It has been the endeavor to include catalogues of all materials and equipment used in highway work which are manufactured in America, Great Britain, France, and Germany. The contents of these files is made available through two indexes—one an index of the names of the companies; the other a subject index, consisting of a card or series of cards containing the names of all companies manufacturing a given material or piece of equipment.

Efficiently Using Library

A library rule of procedure, which has worked out satisfactorily in the Davis Library and has proved of material assistance to users of the library, is as follows: A newcomer is taken in charge by an assistant librarian, who explains the several indexes and the methods of conducting research work in order to make maximum use of the resources of the library.

From the program of co-operation outlined it is obvious that there are innumerable channels through which a college or university may establish relations of value with the engineering divisions of the municipality in which it exists.

How to Handle Sub-contracts

By A. Blair*

It would be ideal if all sub-contracts could be handled by the contractor, just as the government handles their lettings: simply awarding the contract to the lowest bidder who properly qualifies.

In many such instances the government loses by the transaction; not always in actual dollars and cents paid out for actual construction, but in many indirect ways that will occur to all of you; many months' delay in the completion of the building resulting in expense for additional rent, and for salary of government superintendent, much more labor and trouble in the office of the department, unsatisfactory results that have to be accepted in the end.

Why is it that the contractor cannot strictly apply this same method in placing his sub-contracts? Because, if he expects to make his contract a profitable one, or at any rate expects to prevent loss on his contract, his work must go along systematically, his material must be delivered at the proper time, and the work must be accomplished at the proper stage; all the bond in the world will never enable the contractor to progress with his brickwork, for instance, if the brick have not been delivered; and, if there is such a delay, the direct and indirect expense to the contractor is incalculable.

Placing Contract With Lowest Bidder Causes Loss

It is human nature to place a sub-contract with the lowest bidder, and thereby save apparently a goodly sum of money but how often have we each found that this course sometimes results in a loss of more than we expected to gain. It is such risks as these that justify the contractor in undertaking, so far as practicable, to develop mechanics in all the various branches of work, placing in the hands of his foreman the responsibility for the expeditious, economical, and satisfactory execution of the work.

Primarily the argument for a general contractor would be based upon his ability to get branches of his work executed properly, economically, and satisfactorily. Why should a contractor who places the responsibility on his foreman for employing bricklayers and getting brick laid, and carpenters to install the woodwork, find it necessary to make a sub-contract to have the painting done, and to what extent and when is a contractor justified in carrying this plan into further branches of his work?

*Before Association of Government Contractors.

What does he gain by sub-letting such work? The certainty of what it is going to cost, the freedom from detail, the assurance of getting skilled men—all these are good arguments, but what will such a course cost him? and in how many instances is he assured that in the final wind-up he will have secured any or all of these benefits?

Where a contractor goes into a territory that is foreign to him he feels that there is an advantage in placing this responsibility on others who will be more familiar with local conditions, but his lack of familiarity with local conditions carries with it also a lack of knowledge as to who to trust in placing such sub-contracts; and such a lack of knowledge may prove his undoing.

Under what circumstances can a general contractor ordinarily afford to place sub-contracts of this kind? One way would be by having developed sub-contractors who will go from place to place and who, by experience, he will have found able and willing to work as hard as he does and shoulder their responsibility and make good.

In the selection of a manufacturer of material the contractor may go far wrong in selecting the lowest quotation. What is he to do? He can hardly afford to say, "I will never buy from a new man," because the supply of experienced manufacturers would thereby some day be exhausted if that rule were followed generally. It is suggested that he should decline to accept quotations radically below others received, or radically below his judgment of the reasonable amount; he should protect himself in every reasonable way, and he should make special effort to co-operate with the material man, that the probability of errors may be reduced as much as possible.

What has the manufacturer a right to expect from the contractor? Full and complete data, prompt reply to all communications; explicit and plain information; careful handling of material at the building, prompt statement of damage to shipments, or the discovery of errors in work; very prompt and explicit statement of any charge that the contractor may make against him, these statements being supported by proper vouchers, freight bills, or otherwise, to show clearly why such charges are made. Full and prompt compliance with the terms of agreement as to payments. How often we hear the expression that the contractor does business on the money of the material man or sub-contractor.

What has the contractor a right to expect from the manufacturers and from the sub-contractor? Prompt handling of all correspondence; prompt and complete furnishing of the required shop drawings and samples; cheerful acquiescence in the reasonable demands of the superintendent appointed to interpret the specifications; a realization that he, the material man, has undertaken to comply in behalf of the contractor, with all the terms and conditions of the general contract, so far as they relate to his particular part of it.

The contractor has a right to expect from the manufacturer prompt delivery of materials at the time and in the order in which they are needed.

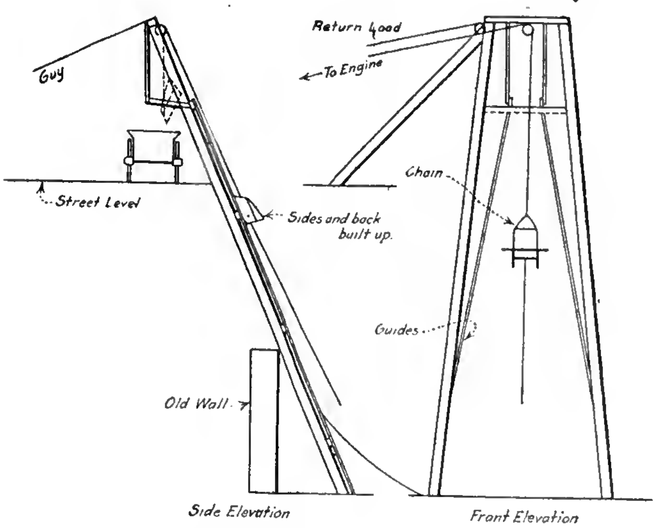
It is entirely possible to arrive at an ideal condition in respect to the transactions between contractor and manufacturer or sub-contractor. There is a legal maxim still quoted in the courts, "Caveat emptor" (let the buyer beware), but surely it must not be a case of "Caveat emptor" between contractor and manufacturer or sub-contractor, but of honest, intelligent co-operation.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Foundation Excavation Carried Out with Drag-line Skip and Stiff-leg Derrick

IN excavating for the foundation for the new plant of the French Brothers-Bauer Company, now being erected in Cincinnati, O., rather unusual conditions had to be met. The foundations of an old brewery, with heavy stone walls and arched ceilings of old wine cellars, some covered with 6 to 10 feet of earth, were to be partly removed and partly reused as foundations of the new building. Some groined arches and brick arches supported on steel beams and cast iron columns were removed. As the elevation of the sub-basement floor varied, the excavation had to be finished in one section before proceeding with another of different elevation.



Drag-line skip excavates for foundations.

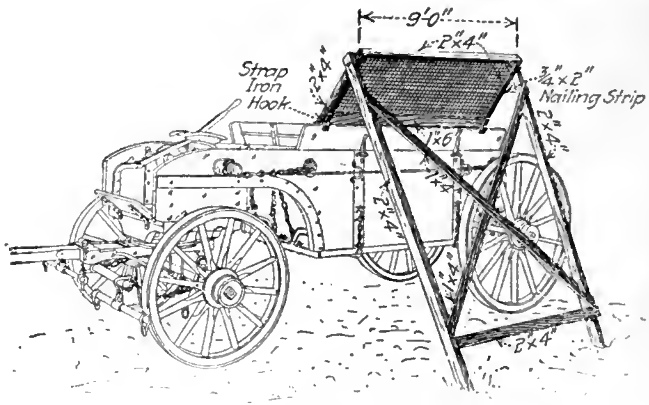
Work began at the east end, to get sufficient earth moved to allow underpinning an existing brick building. On this and the centre portion of the site a stiff-leg derrick with a 60-foot boom, 40-foot mast, and a ¾-yard Owens bucket operated by a Dake swinging engine, was used. This derrick was supported on the old cross-walls and arches on the centre line of the building. The bucket discharged either into wagons direct or into an elevated bin, so that when the teams were not there the derrick could work continuously. An average of 28 yards per hour was maintained, at a labor cost of 48 cents per yard. To haul this about 1¼ miles required 16 teams, the round trip time being about 1 hour 15 minutes. This cost includes tearing out the stone arches and walls.

Owing to the underpinning the east end was not completed until after the remainder of the work was practically finished. The depth here was 30 feet below the street. As room for a derrick was not available, the drag-line skip, as shown in sketch, was erected on the street side, arranged to operate from the concrete hoisting engine. The scraper used was of ½-yard capacity, with the sides and back built up and a chain bail substituted for the iron one. Dirt was taken out at a unit labor cost of 32 cents per yard. This excavation was in sand and loam, and involved no tearing out of walls. This drag-line skip, while it took out dirt cheaper than with the derrick, could not have been used throughout the job on account of the cost of moving and erecting and the interference from cross-walls in other parts of the building.

The old stone walls had been laid up in cement mortar and were in fine condition. The spawls and mortar that had dropped on the haunches, as the main walls were carried above, made the arches exceptionally difficult to wreck. The total yardage moved was 16,500 cubic yards, of which 6,800 cubic yards were stone walls, arches, old floors, etc.

Screen on Side of Wagon Saves Re-Handling Gravel

A SCREEN that is supported by props and by one side of the wagon being loaded is popular in certain sections of Michigan for screening gravel for road-building purposes, because of its saving in cost over screening the gravel on the ground and handling it again to load it into wagons. Using the ordinary masons' screen, the cost of this work averages about 44c per yard for the screened product, including loading. About one-third of the material handled is waste. By throwing the material against the wagon screen, allowing the waste to drop to the ground and the screened gravel to roll into the wagon, the cost given is cut to about 22c per yard.



Screen cuts cost of handling gravel by avoiding re-handling.

The screen used is 3 ft. wide, and the length of the dump wagon is usually about 9 ft. The frame is made of 2 x 4-in. scantling, with two cross-braces of the same material. It is covered with screen wire having 1/4-in. to 1/3-in. mesh, which gives a satisfactory product. The angle at which the screen is set can be varied to suit the material being dug. The lower edge of the screen is provided with hooks to hang on the side boards of the wagon, while the other side of the screen is supported by posts hinged on bolts to the edge of the frame.—Engineering News-Record.

Convention of Western Canada Irrigation Association

The Western Canada Irrigation Association are holding their fourth annual convention at Maple Creek, Sask., this week—August 1, 2, and 3. This is the first occasion on which the convention has been held outside of the Provinces of Alberta and British Columbia, and it is particularly appropriate that Maple Creek should have been selected, as it is the centre of the most important irrigation enterprises in the Province of Saskatchewan. Within a reasonable area there are 195 private irrigation schemes.

Trade Publication

Steel Lockers—The Dennis Wire and Iron Works Company, Limited, London, Ont., are distributing literature describing their "Dennisteel" lockers. It is pointed out that these are fireproof, indestructible, sanitary and of good appearance; further, that they are a considerable aid in the ever-growing welfare movement which is to provide for the health, comfort and convenience of working people that they may be more contented, easier to handle, less liable to change and more loyal to their employers. From this viewpoint the Dennisteel locker is a permanent investment rather than an expense.

Mainly Constructional

East and West—From Coast to Coast

A $40,000 factory is to be erected in Toronto by the Dominion Envelope Company. It will be on Duchess Street, west of Ontario.

After drilling two days at the south end of the town of Aurora, Ont., a well was struck with a capacity of 180,000 gallons a day. The water is very pure and the well is only 95 feet deep.

The Stouffville, Ont., public school recently destroyed by fire is being replaced by a new one, costing $30,000. The foundation is now completed and debentures have been issued to cover the cost of completion.

Investigation will be made into the feasibility of using scrapped pavement for repairing roads in the vicinity of Mimico, Ont. A quantity of this material will be available from the old Lake Shore Road, which is being reconstructed.

Trustees of the Carnegie Library Fund are prepared to spend $75,000 on the construction of three public libraries in Vancouver, B.C., providing they will be maintained by the city. The city council will ascertain the probable maintenance cost.

Concreting has been resumed on the Toronto-Hamilton Highway from Stop 29 easterly. As far as New Toronto is fully graded and the remainder is being rapidly put in shape. With 40 men and one large mixer the road is going forward at the rate of 250 feet a day.

It is anticipated that the Bloor Street Viaduct, Toronto, will be open for pedestrian traffic this year. The engineer in charge reports labor and material both plentiful. A conference between the city engineering authorities and the contractors has been arranged with a view to speeding up operations.

The portion of Kingston Road which connects Toronto with Oshawa is to be taken over as a part of the new provincial highway system, by which the province assumes 70 per cent. of the costs and the balance is apportioned between the various municipalities served by the highway.

The Toronto and York Highway Commission are actively engaged in laying out the new bridge at Locust Hill, Ont. It will be of reinforced concrete, about 80 feet long with three spans. The work will cost approximately $12,000, and will be completed in about six months.

The Dominion Textile Company will erect a big plant at St. Lambert, Que. It is anticipated there will be 100,000 spindles and 3,000 looms. Employees will number from 1,500 to 2,000, and the cost of the undertaking, including the machinery, based on pre-war prices, will be about $2,750,000.

A deputation from Owen Sound, Markdale, Collingwood and the township of Nottawasaga and counties of Grey, Simcoe and Dufferin, recently waited on the Minister of Highways of Ontario, requesting that the government take over and establish as part of the provincial highway system, the road from Port Credit to Owen Sound.

The Eaton highway, which runs from Summerville to Lambton, Ont., and which is now being rebuilt, is being covered with a mixture of macadam, concrete and hard stone. The Dominion Government is taking motion pictures of this four-mile road which will be shown in Toronto in the near future, along with many other picturesque highways in the Dominion.

The Toronto board of control have decided to approve the use of asphalt in the re-laying of the track allowance on Dundas Street from Ossington to Lansdowne. The cost will be approximately $70,000, as compared with estimated amounts of $90,000 for creosoted wood blocks and $80,000 for granite setts. Many arguments were brought forward showing that the ultimate saving by the use of wood blocks offset the present cost, but these had no weight with our war-time economists.

A very substantial pair of concrete silos has been constructed on a farm in Egremont township, Ont. One is twelve by thirty-four. The walls are eleven inches at the base and six inches at the top. It was erected by the farmer himself with the aid of a hired man, buying a set of wooden rings to serve as molds. When the silo was built the molds were sold for what they cost. The actual cash outlay was only $56. The work of erecting the other silo was let by contract and cost $75. These expenditures were exclusive of the cost of gravel—there being an abundance in the neighborhood.

Personals

Mr. R. J. Cole, C.E., of Syracuse, N.Y., was recently in Hamilton, Ont., looking into conditions for the erection of a large coke plant in that city at the foot of Depew Street, for the Semet-Solway Coke Company.

Mr. R. H. Parks has been appointed operating manager of the Canadian Car and Foundry Company, Montreal, and will have charge of all the car plants of the company. He has been identified with the car building industry for many years, coming to Canada from the Bettendorf Car Company of Davenport, Iowa.

Obituary

Lieut. Thos. B. Greer, formerly of the Toronto city architect's department, died in France recently from wounds received while in action.

Tenders and For Sale Department

Tenders Wanted

The Corporation of the Town of Harriston ask for tenders for the construction of a Municipal Drain in said Town, consisting of 4,183 feet of tile drain and sewer pipe from 7-inch to 24-inch diameter and also a small portion of open ditch.

Plans, profile and specifications can be seen at the office of W. D. McLellan, Harriston, to whom all tenders should be addressed not later than **August 7th, 1917.**

A marked cheque for $150 to accompany each tender. Unsuccessful tenderers will have their cheques returned.

The lowest or any tender not necessarily accepted.

W. D. McLELLAN,
Harriston, Ont.

Harriston, July 24th, 1917. 30-31

Tenders for Concrete or Tarvia Pavement

Sealed tenders, marked "Tender for Pavements," will be received by Mr. F. L. Heath, Clerk, Georgetown, up to 5 o'clock p.m., **August 10th, 1917**, for approximately 3,000 square yards of Concrete or Tarvia Pavement in Georgetown.

Plans and specifications may be seen at the Clerk's office, Georgetown, or at the Engineer's office, 130 Lancaster St. E., Kitchener.

The lowest or any tender will not necessarily be accepted.

HERBERT JOHNSTON,
Consulting Engineer,
Kitchener, Ont.

30-31

Tenders for Drainage Work

Sealed tenders, addressed to the undersigned will be received up to noon on **Monday, the 20th day of August, 1917**, for the construction of the McGrath Drain in the Township of Hibbert.

Plans and specifications may be seen at the Clerk's office, Dublin, Ont.

A deposit in the form of a marked cheque for five per cent. of the amount of tender must be enclosed and will be returned when a contract has been signed.

The lowest or any tender not necessarily accepted.

JAMES JORDAN,
Clerk, Township of Hibbert,
Dublin, Ont.

Clerk's Office,
Dublin, July 18th, 1917. 30-32

Tenders for Drain

Tenders will be received up to 12 o'clock noon, **August 20th**, for the construction of a ditch, under "The Municipal Drainage Act," in the 1st, 2nd and 3rd Concessions of the Township of Greenock, in the County of Bruce.

Length of drain about three and a third miles. Clearing willows, slash, and bush and estimated excavation of 15,500 cubic yards.

Engineer's report, plans and profile may be seen at the clerk's office, Lot 15, Con. 14, Greenock. Council will meet at Chepstow on Monday, August 20th, to open and consider tenders. The lowest or any not necessarily accepted.

THOS. H. PURDY,
Clerk of Greenock,
Glamis P. O.
R. R. 1. Ont.

Dated July 10th, 1917. 29-32

Public Utilities Commission of Strathroy

Tenders are requested for building Concrete Reservoir and Pump Houses. Specifications and Tender Forms may be obtained from Messrs. Kerry & Chace, Engineers, Toronto, or Public Utilities Commission, Strathroy, Ont.

Tenders received by Public Utilities Commission, Strathroy, up to noon, **August 8th, 1917.**

The lowest or any tender not necessarily accepted. 31-31

For Sale
MOTORS and PUMPS

2 centrifugal pumping units complete as follows:—2—24-in. Suction, 24-in. Discharge centrifugal pumps direct connected to Canadian Westinghouse induction motors, Type H.F., Constant Speed, 750 H.P., 2200 Volts, 25 Cycle, 3 Phase, 175 Amp. per terminal, 292 R.P.M., complete with circuit breaker and starter.

These units are practically new and have received good care and can be purchased as a whole or in part.

CANADIAN STEWART CO., LTD.,
Dominion Bank Building,
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Tenders Wanted for
Plumbing, Pipes and Fixures
Parliament Buildings, Ottawa

Sealed tenders will be received by the undersigned until noon, **August 27, 1917**, for Plumbing Pipes and Fixtures required in the re-construction of the above building.

All tenders to be based on the execution, erection and completion, including all labor and materials required for the installation of the Plumbing system, together with all fixtures, apparatus and appliances as called for in the Plans and Specifications.

Plans, Specifications and any other information can be obtained at the office of the General Contractors, P. Lyall & Sons Construction Company, Limited, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Minister of Public Works, for a sum not less than Ten (10 p.c.) per cent. of the amount of the tender, which will be forfeited if the parties tendering decline to enter into a contract when called upon to do so. If the tender is not accepted the cheque will be returned. The total security will be forfeited if the contractor fails to complete the work contracted for.

Payments will be made monthly and will not exceed in the aggregate Ninety (90 p.c.) per cent. of the value of the labor and materials furnished and set in place.

Accompanying the tender shall be a detailed bill of quantities of all material and labor properly priced out which shall aggregate the contract price.

The lowest or any tender not necessarily accepted.

Envelopes containing tenders to be marked "Tenders for Plumbing Pipes and Fixtures," and addressed to the undersigned.

JOHN A. PEARSON, Architect.
J. O. MARCHAND, Associate.

Centre Block,
Parliament Buildings,
Ottawa. 31-32

Wanted—Stenographer

for general work in publishing house; lady, or man ineligible for active service; must transcribe accurately, operate rapidly and be good on detail—an all-round, capable assistant.

Hugh C. MacLean, Limited,
31 347 Adelaide St. W., Toronto.

Notice to Contractors

Sealed tenders endorsed "Tender for St. Lawrence Street, Madoc," will be received by the undersigned until noon on **Monday, August the 13th, 1917**, for the construction of a waterbound macadam road on St. Lawrence Street in the Village of Madoc.

Plans, specifications and forms of tender may be seen at the office of the undersigned, also at the office of the Reeve of the Village of Madoc.

Each tender must be accompanied by an accepted bank cheque payable to the undersigned for five per cent. of the amount of the tender and this amount will be forfeited if the person or persons tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. The signatures and addresses of two sureties or the name of a guaranty company approved by the Department and willing to provide a bond for the due fulfilment of the contract must accompany each tender.

The lowest or any tender not necessarily accepted.

W. A. McLEAN,
Deputy Minister of Highways.

Department of Public Highways,
Toronto, July 30th, 1917.

Papers publishing this advertisement without authority will not be paid. 31-31

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$600,000.00 Worth of Released Machinery Consisting of

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Principal Contents

Manitoba's Bridges

THE Province of Manitoba is not taking second place to the rest of Canada in the matter of its road-building program. The government's sympathy with the good roads movement is shown by the progressive legislation that has been enacted, which offers liberal assistance to municipal councils. With government subsidies as an incentive, gratifying progress has taken place in the improvement of market roads throughout the province. In addition, however, to promoting the betterment of highways, the government, through the Good Roads Board, which administers the Good Roads Act, is subsidizing highway bridges, and thereby securing a better class of structure than has heretofore been constructed. During the past year vast improvement has been noted in regard to the erection of more permanent bridges, and there has been a disposition on the part of many councils to dispense with the old-time wooden structure of inferior design and substitute therefor bridges of a more durable and permanent type. Government assistance is given to the extent of one-third the cost of timber bridges costing not less than $500 and to the extent of one-half the cost of permanent bridges the cost of which is not less than $200. The Good Roads Act defines very definitely the procedure of municipalities in constructing bridges to meet the requirements of the Board, and states rigorously the steps to be pursued to secure the highest degree of workmanship and quality.

* * *

An article written for the Contract Record by Mr. P. Burke Gaffney, bridge engineer of the Manitoba Good Roads Board, which appears in this issue, serves to illustrate the growing realization throughout the province of the inefficiency of the old, patched-up timber bridge which has been a feature of Manitoba for so long and the determination among progressive municipalities to effect its elimination. It was a hard row to hoe to educate the people to a recognition of the value of permanent construction, but the total failure of a great many temporary bridges by the severe spring floods brought home in a practical way the loss due to disruption of traffic and the imminence of accident. Timber bridges are a luxury that cannot be afforded by any municipality, and, least of all, by the poorer ones. Seventy-one per cent. of the bridges built last year were of permanent types—steel or concrete. This illustrates the extent to which municipalities are favoring the superior styles, though more expensive in initial outlay.

One feature of Manitoba's bridge work is the consideration given to aesthetic appearance. Excessive ornamentation would be out of place on a rural highway in Manitoba, or any other province, but there are certain cardinal principles that can be followed in an endeavor to harmonize a bridge with its surroundings. The illustration of the White Mud River bridge in the article referred to portrays the simple ruggedness that is regarded as meeting the practical architectural requirements of rural bridges in the province.

The Good Roads Board of Manitoba is very stringent in its requirements regarding workmanship. Carefully-prepared specifications are rigorously adhered to and all materials are carefully analyzed for quality. High-grade inspection is a forte of the Board's work. It is realized that the success of bridge building in the future depends on the creation of a corps of competent inspectors. The Board's efforts have been directed to securing the maximum service from the bridges placed in operation through its direction, and to this end is prepared to make special studies to meet unusual conditions. Throughout the province, however, ordinary circumstances can be met by a standard structure, and the board has prosecuted the preparation of such standardized plans as will minimize duplication of effort.

* * *

Labor conditions in Manitoba have, as elsewhere, been uncertain. The contract system has, in most instances, been employed. With the growing uncertainty of the market, day labor has been used successfully in the main. The benefit of competitive tendering from persons equipped with suitable plants is, however, urged for normal times. The cost of bridge construction has been higher during the past year than ever before, but concrete designs appear to have advanced to a lesser degree than those of steel or timber.

Summarizing, the following points, as outlined by the author of our article in his last report, combine the main elements associated with bridge building in Manitoba:

1. The economy of permanent structures is well established, and is recognized by the more enlightened and progressive municipalities.

2. Bridge building has received an impetus from the total or partial destruction of a large number of old timber structures, making new construction imperative.

3. The department has now on hand standards to fit any ordinary conditions, and has investigated special types for unusual locations.

4. The specifications under which work is carried out are standardized and the methods of testing materials are established so the utilization of the very best materials is insured.

Shingle Roofs the Bugbear!

ON May 21, 1917, an immense conflagration destroyed a large part of the city of Atlanta, Ga., U.S.A. The total property loss was estimated at about $5,500,000, while about 10,000 people were rendered homeless. The fire devastated a total area of 360 acres, with 1,938 buildings, 1,891 of which were of frame construction, the remainder being brick. Of the total number of buildings 80 per cent. had shingle roofs. Besides the loss directly attributable to the immediate effects of fire on the homes and business buildings considerable damage was done to railway and telephone equipment and fire-fighting appliances.

The fire has recently been investigated by the National Board of Fire Underwriters, and many points of the report are of general interest to municipal officials connected with city building regulations. Wooden shingle roofs are largely blamed for the spreading of the fire, and a series of photographs accompanying the report show the development of five separate fires, all started from flying brands alighting on nearby shingle roofs.

A brief summary of the conclusions reached by the underwriters follows:

Shingle Roofs Dangerous

This conflagration, together with two of the other fires occurring at the same time, emphasizes the ease with which spreading fires may develop in cities where wooden shingle roofs predominate, even when the fire department is mainly well equipped and manned. It illustrates the startling suddenness with which a fire may grow into a conflagration under favorable conditions. For a period of eight hours the remaining part of the city, including the business district, was practically without protection. A shift of the wind during the progress of the fire would have resulted in a corresponding change in the path of devastation, and might have involved the business district, where the high values of the city exist, for it would have been impossible to stop the spread through the shingle roof area, which even now extend to the edge of that district. The fire department apparently worked well and efficiently, but all of its efforts were of little avail because of the prevalence of shingle roofs, which permitted flying brands to start local fires blocks beyond the actual fire and far ahead of the location of the fire apparatus.

Motor apparatus instead of horse-drawn equipment is strongly recommended because of its superiority in covering long-distance runs. The value of high pressures on the distribution system is shown by the extensive use of hose lines direct from hydrants. Places where these were reported as too weak to be effective were mainly on high ground, where the gridiron was weak. The need of a complete secondary feeder system is evident in this connection, and the more general use of 8-in. mains for minor distributors in sections along the edge of the system would have improved the supply.

Equipment for Combating Fire

Although no shortage of pump or of boiler capacity was experienced, all equipment at the pumping station was in use. Had one of the units been out of service for repairs, or had it broken down during the fire, conditions might have been serious. The need of ample reserve in both pumps and boilers to provide for such contingencies is evident. Numerous hydrants in districts of this character and hydrants of good dimensions, with steamer outlets and 6-in. connections to the mains, are evidently needed to combat a spreading fire.

Improved streets are of material value in a conflagration of this kind, as in many sections the unimproved stretches make long detours necessary for the apparatus.

Sprinklered buildings did not have a very extensive test, as only one was directly exposed to the conflagration. This one, however, stood up very well as a fire-stop, the flow forming a water-curtain down one face. As no fireproof buildings or semi-fireproof buildings were in the path of the fire, no test of these was available.

The usual difficulties with different sizes of hose, couplings, and thread were experienced in the use of equipment from neighboring cities.

The value of dynamiting buildings to prevent spread of fire in this case is questionable. It is not apparent from the ruins that any good resulted from such work.

Will Wages Fall After the War?

THERE is a tendency, states "The Engineer and Architect," to regard the present rates of "war wages" as being merely temporary rates, that will recede to the former level shortly after the world war ends. Without doubt the prices of some materials—copper and steel, for example—will drop, but he is no student of wage rates who predicts a similar drop in wages.

Curves of wage rates have never followed curves of market prices, rising and falling with every tide of demand. Wages, it is true, have risen as a whole when prices as a whole have risen, and occasionally, but not always nor to so marked a degree, wages have receded as a whole when average prices have gone down. But wage-earners are prone to cling stubbornly to every increase, and ultimately to maintain nearly all, if not all, of the increase. This has been notable in the industries where labor unions are powerful, but it has also been conspicuous in other industries. Increased wages, of course, cannot be permanently maintained unless there is increased output of the workmen. But increased output is one of the things that high wages beget, and this comes about in two major ways: First, through the efforts of the employer and his managers to increase the efficiency of high-priced workmen;

second, through the efforts of the men themselves to "make good."

High Wages to Stay

It was reserved for Mr. Henry Ford to show in a spectacular manner that a $5 minimum wage would serve to speed up shopworkers to an unprecedented degree. There is a vast deal of "bunk" along with some truth in the common statement that "high wages breed inefficient workmen." For the most part, this is not true, and it is rarely true where the employer takes pains to arouse the workman's ambition and to cultivate his good-will at the same time.

The workmen of Europe are receiving higher wages than ever before, and they are also delivering more units of product per man-day than ever before. They, too, will not go back to lower wage rates, for they, as well as their employers and their governments, have learned a lesson. This, in its turn, will assist in keeping up the wage rates in America.

Higher wage rates are here to stay—at least, until they go still higher. He that defers construction until there shall be a marked fall in wages will never construct anything.

The conclusions to be drawn by managers of public and private enterprises, according to Engineering and Contracting, are these: Go ahead now with every project that will return an adequate saving or profit in normal times. Aim to secure minimum unit costs by careful design, by the use of labor-saving machinery, and by vigorous driving of project to a finish. It is not overstating matters, we believe, to assert that if the best of present designs were substituted for the present average design, fully 25 per cent. of the cost of materials can be eliminated. This can be effected in some cases by substitution of one kind of material for another kind, but in most cases it can be effected by a better use of the materials now used. The average output of workmen is susceptible also of fully 25 per cent. betterment merely through better management. But, in addition, the more extensive use of labor-saving machines and devices can be counted upon to secure a still greater reduction in unit costs.

For the moment unit construction costs are relatively high, and some of them may long remain at the present level. Mere passivity, however, will not reduce them. High wages are here to stay. Whether lower unit costs are to be attained is distinctly "up to us"—the engineers and contractors. And we cannot attain them by waiting. They are attainable only by the exercise of our wits. The time for that exercise is now. Engineers should encourage their clients and employers to go ahead with projects that would normally be put through.

Old Concrete Roads Resurfaced

THE Wayne County, Michigan, road commissioners give, in their tenth annual report, a description of placing a 3-in. surface of new concrete on an old concrete road, which was widened at the same time from 16 to 20 feet.

A section of a road, built in 1910, was selected for this work because it was rough and uneven, and also because it carried a heavy mixed traffic. The section was of two-course construction, 16 feet wide, built on a crowned subgrade. The bottom course was a 1:2½:5 mix, 4 inches thick, and the wearing course a 1:2:3 mix, 2½ inches thick. It was put down in 25-ft. sections with ¼-in. tar paper strips cutting entirely through the concrete. The surface, which was struck off with a template, was somewhat irregular in finish, as at the time the road was constructed the same degree of care in finishing was not exercised that is demanded now. Also the edges of the pavement had been rounded off on a 3-in. radius, a practice now abandoned.

The rounded edge was broken off and concrete added on each side of the road, to make a total width of 20 feet. The tar surfacing and filling were removed and replaced with concrete to make an even surface 20 feet wide. At those joints where the concrete had spalled to a considerable extent the old concrete was broken away sufficiently to give a bond for new concrete on both sides of the joint. Expansion felt was placed, and the whole surface brought to an even grade. On the top layer of this base was placed a 3-in. layer of 1:1½:2½ concrete, using for coarse aggregate Michigan trap rock, graded in size from ¼ in. to 1 in., and washed and screened bank sand for the fine aggregate. No. 26 triangular mesh-wire reinforcement was placed and no attempt was made to bond rigidly the top course to the old road. The surface of the old concrete was first sprinkled with water and then a mixture of Tarvia A and Tarvia X was sprinkled on while hot before placing the new wearing surface. The tar spread in a very thin layer, and was immediately chilled, forming a coat over the old surface.

The expansion joints in the top course were made to coincide exactly with the expansion joints in the bottom course. A piece of wood, 3 in. x 4 in. x 20 ft. long, was placed over the old joint, and the concrete deposited as though no joint was to be made. After the surface had been finished by the Baker automatic finishing machine this piece of wood was removed and armor plates with expansion felt were set into place on the wide forms, the felt of the new joint coinciding with the tar paper of the base joint. A slight movement due to expansion or heaving will not result in cracks in the top course, which would occur if the top were rigidly bonded to the old surface. The tar, although thinly spread, permits a slight movement of each course without interfering with the other. The surface was covered with earth, which was kept on for two weeks, being sprinkled daily. Traffic was permitted to use the road 25 days after the last concrete had been placed.

Shipbuilding Superintendent

Some responsible parties desire to get in touch with a capable superintendent to take charge of the building of small steamships for a company which is going into this work in France. There would be a splendid opening for a man with boat-building experience, speaking both languages. Further information by addressing "Ship-Builder," care of "Contract Record," Toronto.

The stonecutters' union of Montreal has complained to the Roman Catholic school commissioners that work which should be done in the city is sent to outside points. The 400 stonecutters found it very difficult to obtain employment, and it was asked that a clause be inserted in every contract obliging contractors to employ Montreal stonecutters. The commissioners decided to investigate the matter.

General Design of Concrete Structures

Continuation of Joint Committee's Report on Re-inforced Concrete Covers Planning of Columns, Beams and Slabs

DESIGN

1. Massive Concrete

In the design of massive or plain concrete, no account should be taken of the tensile strength of the material, and sections should usually be proportioned so as to avoid tensile stresses, except in slight amounts to resist indirect stresses. This will generally be accomplished in the case of rectangular shapes if the line of pressure is kept within the middle third of the section, but in very large structures, such as high masonry dams, a more exact analysis may be required. Structures of massive concrete are able to resist unbalanced lateral forces by reason of their weight; hence the element of weight rather than strength often determines the design. A leaner and relatively cheap concrete, therefore, will often be suitable for massive concrete structures.

It is desirable generally to provide joints at intervals to localize the effect of contraction.

Massive concrete is suitable for dams, retaining walls, and piers in which the ratio of length to least width is relatively small. Under ordinary conditions this ratio should not exceed four. It is also suitable for arches of moderate span.

2. Reinforced Concrete

The use of metal reinforcement is particularly advantageous in members such as beams in which both tension and compression exist, and in columns where the principal stresses are compressive and where there also may be cross-bending. Therefore, the theory of design here presented relates mainly to the analysis of beams and columns.

3. General Assumptions

(a) **Loads.**—The forces to be resisted are those due to:

1. The dead load, which includes the weight of the structure and fixed loads and forces.

2. The live load, or the loads and forces which are variable. The dynamic effect of the live load will often require consideration. Allowance for the latter is preferably made by a proportionate increase in either the live load or the live load stresses. The working stresses hereinafter recommended are intended to apply to the equivalent static stresses thus determined.

In the case of high buildings the live load on columns may be reduced in accordance with the usual practice.

(b) **Lengths of Beams and Columns.** — The span length for beams and slabs simply supported should be taken as the distance from centre to centre of supports, but need not be taken to exceed the clean span plus the depth of beam or slab. For continuous or restrained beams built monolithically into supports the span length may be taken as the clear distance between faces of supports. Brackets should not be considered as reducing the clear span in the sense here intended, except that when brackets which make an angle of 45 degrees or more with the axis of a restrained beam are built monolithically with the beam, the span may be measured from the section where the combined depth of beam and bracket is at least one-third more than the depth of the beam. Maximum negative moments are to be considered as existing at the end of the span as here defined.

When the depth of a restrained beam is greater at its ends than at midspan and the slope of the bottom of the beam at its ends makes an angle of not more than 15 degrees with the direction of the axis of the beam at midspan, the span length may be measured from face to face of supports.

The length of columns should be taken as the maximum unstayed length.

(c) **Stresses.**—The following assumptions are recommended as a basis for calculations:

1. Calculations will be made with reference to working stresses and safe loads rather than with reference to ultimate strength and ultimate loads.

2. A plane section before bending remains plane after bending.

3. The modulus of elasticity of concrete in compression is constant within the usual limits of working stresses. The distribution of compressive stress in beams is therefore rectilinear.

4. In calculating the moment of resistance of beams the tensile stresses in the concrete are neglected.

5. The adhesion between the concrete and the reinforcement is perfect. Under compressive stress the two materials are, therefore, stressed in proportion to their moduli of elasticity.

6. The ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete is taken at 15, except as modified later.

7. Initial stress in the reinforcement, due to contraction or expansion of the concrete, is neglected.

It is recognized that some of the assumptions given herein are not entirely borne out by experimental data. They are given in the interest of simplicity and uniformity, and variations from exact conditions are taken into account in the selection of formulas and working stresses.

The deflection of a beam depends upon the strength and stiffness developed throughout its length. For calculating deflection a value of 8 for the ratio of the moduli will give results corresponding approximately with the actual conditions.

4. T-Beams

In beam and slab construction an effective bond should be provided at the junction of the beam and slab. When the principal slab reinforcement is parallel to the beam, transverse reinforcement should be used extending over the beam and well into the slab.

The slab may be considered an integral part of the beam, when adequate bond and shearing resistance between slab and web of beam is provided, but its effective width shall be determined by the following rules:

(a) It shall not exceed one-fourth of the span length of the beam.

(b) Its overhanging width on either side of the web shall not exceed six times the thickness of the slab.

In the design of continuous T-beams due consideration should be given to the compressive stress at the support.

Beams in which the T-form is used only for the purpose of providing additional compression area of concrete should preferably have a width of flange not more than three times the width of the stem and a thickness of flange not less than one-third of the depth of the beam. Both in this form and in the beam and slab form the web stresses and the limitations in placing and spacing the longitudinal reinforcement will probably be controlling factors in design.

5. Floor Slabs Supported Along Four Sides

Floor slabs having the supports extending along the four sides should be designed and reinforced as continuous over the supports. If the length of the slab exceeds 1.5 times its width the entire load should be carried by transverse reinforcement.

For uniformly distributed loads on square slabs one-half the live and dead load may be used in the calculations of moment to be resisted in each direction. For oblong slabs, the length of which is not greater than one and one-half times their width, the moment to be resisted by the transverse reinforcement may be found by using a proportion of the live and dead load equal to that given by the formula $r=l/b-0.5$, where l=length and b=breadth of slab. The longitudinal reinforcement should then be proportioned to carry the remainder of the load.

In placing reinforcement in such slabs account may well be taken of the fact that the bending moment is greater near the centre of the slab than near the edges. For this purpose two-thirds of the previously calculated moments may be assumed as carried by the centre half of the slab and one-third by the outside quarters.

Loads carried to beams by slabs which are reinforced in two directions will not be uniformly distributed to the supporting beams, and the distribution will depend on the relative stiffness of the slab and the supporting beams. The distribution which may be expected ordinarily is a variation of the load in the beam in accordance with the ordinates of a parabola, having its vertex at the middle of the span. For any given design the probable distribution should be ascertained and the moments in the beam calculated accordingly.

6. Continuous Beams and Slabs

When the beam or slab is continuous over its supports, reinforcement should be fully provided at points of negative moment, and the stresses in concrete recommended later should not be exceeded. In computing the positive and negative moments in beams and slabs continuous over several supports, due to uniformly distributed loads, the following rules are recommended:

(a) For floor slabs the bending moment at centre and at support should be taken at $wl^2/12$ for both dead and live loads, where w represents the load per linear unit and l the span length.

(b) For beams the bending moment at centre and at support for interior spans should be taken at $wl^2/12$, and for end spans it should be taken at $wl^2/10$ for centre and interior support, for both dead and live loads.

(c) In the case of beams and slabs continuous for two spans only, with their ends restrained, the bending moment both at the central support and near the middle of the span should be taken at $wl^2/10$.

(d) At the ends of continuous beams the amount of negative moment which will be developed in the beam will depend on the condition of restraint or fixedness, and this will depend on the form of construction used. In the ordinary cases a moment of $wl^2/16$ may be taken; for small beams running into heavy columns this should be increased, but not to exceed $wl^2/12$.

For spans of unusual length, or for spans of materially unequal length more exact calculations should be made. Special consideration is also required in the case of concentrated loads.

Even if the centre of the span is designed for a greater bending moment than is called for by (a) or (b), the negative moment at the support should not be taken as less than the values there given.

Where beams are reinforced on the compression side the steel may be assumed to carry its proportion of stress in accordance with the ratio of moduli of elasticity, as described later. Reinforcing bars for compression in beams should be straight and should be two diameters in the clear from the surface of the concrete. For the positive bending moment such reinforcement should not exceed 1 per cent. of the area of the concrete. In the case of cantilever and continuous beams, tensile and compressive reinforcement over supports should extend sufficiently beyond the support and beyond the point of inflection to develop the requisite bond strength.

In construction made continuous over supports it is important that ample foundations should be provided; for unequal settlements are liable to produce unsightly, if not dangerous, cracks. This effect is more likely to occur in low structures.

Girders, such as wall girders, which have beams framed into one side only, should be designed to resist torsional moment arising from the negative moment at the end of the beam.

7. Bond Strength and Spacing of Reinforcement

Adequate bond strength should be provided. The formula hereinafter given for bond stresses in beams is for straight longitudinal bars. In beams in which a portion of the reinforcement is bent up near the end the bond stress at places, in both the straight bars and the bent bars, will be considerably greater than for all the bars straight, and the stress at some point may be several times as much as that found by considering the stress to be uniformly distributed along the bar. In restrained and cantilever beams full tensile stress exists in the reinforcing bars at the point of support, and the bars should be anchored in the support sufficiently to develop this stress.

In case of anchorage of bars an additional length of bar should be provided beyond that found on the assumption of uniform bond stress, for the reason that before the bond resistance at the end of the bar can be developed the bar may have begun to slip at another point, and "running" resistance is less than the resistance before slip begins.

Where high bond resistance is required, the deformed bar is a suitable means of supplying the necessary strength. But it should be recognized that even with a deformed bar initial slip occurs at early loads, and that the ultimate loads obtained in the usual tests for bond resistance may be misleading. Adequate bond strength throughout the length of a bar is preferable to end anchorage, but, as an additional safeguard, such anchorage may properly be used in special cases. Anchorage furnished by short bends at a right angle is less effective than by hooks consisting of turns through 180 degrees.

The lateral spacing of parallel bars should be not less than three diameters from centre to centre, nor should the distance from the side of the beam to the centre of the nearest bar be less than two diameters. The clear spacing between two layers of bars should be not less than 1 in. The use of more than two layers is not recommended, unless the layers are tied together by adequate metal connections, particularly at and near points where bars are bent up or bent down. Where more than one layer is used, at least all bars above the lower layer should be bent up and anchored beyond the edge of the support.

(To be continued.)

Night Work for Contractors

Does It Pay?—It Does When Plant Obsolescence and Wear-Out Are Considered—Better to Double-Shift Equipment than Double-Track Plant

By J. L. Harrison

ROUGHLY speaking, contracting costs may be divided among (1) materials, (2) labor and its superintendence, and (3) plant. Now, it will not be seriously contended that items falling in the first classification are modified appreciably by working at night. Items in classification (2) may be —in fact, usually are—modified unfavorably by night work as ordinarily carried on. Here the average contractor usually closes his analysis of the situation and asserts the increased cost of night work. However, if he would analyze the third classification—his plant cost—he would often find a gain that would more than offset any necessary labor loss.

Years ago the writer worked for a time in the East Pittsburg plant of the Westinghouse Electric and Manufacturing Company. Even then this plant was enormous, but it lay absolutely idle during more than half of each working day. Had the plant been only half as large and worked two shifts instead of one, the labor cost would have been about the same, but the plant charges would have been cut about in two, to the great advantage of the company. A vivid idea of what this may mean in dollars and cents can be had by analyzing the annual report of any large industrial company.

Obsolescence the Main Factor

It is pretty generally admitted that machinery and equipment usually become functionally obsolete before they are worn out. In other words, old machines are scrapped because new ones can be secured to do their work better and cheaper, rather than because the old ones are actually worn out. Depreciation is not, therefore, as accurately expressed as a function of the number of hours work done by a machine as it is as a function of human progress; and it is consequently possible to reason that, if one man gets two hours of work out of a machine where his neighbor gets only one, he has obtained a large advantage. The phenomenal success of the Ford factory is, in no small degree, based on this principle. Usually people talk of the "low capitalization" of this unique plant. This low capitalization is, of course, a reality, but its interest for the contractor lies in the fact that there is probably no other plant in the world where the full capacity of the equipment used is so nearly reached as at the Ford plant.

Now, to come back to the question of night work, it is both more easy to maintain a high labor efficiency in night factory work and to see the lower plant costs per unit of work done on two- or three-shift work, when factory conditions are considered than when ordinary contract work is examined. Yet the same general conditions prevail. In the first place, successful night work depends absolutely on adequate light. This is not so much dependent on the quantity of light as on its proper distribution. A few large lighting units may throw more light than a good many small units; but if they are so placed that they throw heavy shadows, the work done under them is almost sure to be inefficient.

Men Get Used to It

In the next place, night work must be kept up so long that the laborers get used to it. This is very important. In fact, the impression that night work is expensive is largely due to the high costs that have been obtained during abortive experiments with it.

Another point of considerable importance is the fact that, for some reason, contractors usually put their best superintendents on the day shift and their second-rate men on the night shift. This has an adverse effect on efficiency in general, and results in unfair conclusions as to labor costs.

When the excessive temperature of the daylight hours during the summer months is considered, it seems remarkable that more effort has not been made to develop the possibilities of night work. The writer can find no adequate reason for it, either in factory production or on contract work, unless it be the natural preference of all normal human beings for daylight work. However, plant and equipment are becoming a larger and larger percentage of the unit costs of the finished product, in both factory and field production, and unit costs can be reduced in no other way so easily as by making the rate of actual useful wear on the plant at least keep up with the rate of functional depreciation. At present this can be done only by working two or more shifts.

Night Work Pays Dividends to Railroads

Not so long ago railroads of America ran only during the daylight hours. But where is the railroad in America to-day that could stop running at night and pay dividends? The increased capital cost that would be required to handle the present railroad business between sunrise and sunset would be tremendous. In the Philippine Islands an English concern has been running a railroad on the daylight plan. Its president told the writer not long ago that he guessed the road would have to be double-tracked before it could pay dividends. We smile over such antediluvian ideas—yet many of our American factories and most of our contractors are planning to double-track their plants rather than double-shift their present equipment. The railroads have stood up nicely under the "lower labor efficiency" of night work, and so has the Ford plant. And so could every contractor who has more work than equipment, if he would give the matter his careful attention.

A Romance of Industry

Miracles of Manufacturing Accomplished by the British Ministry of Munitions—Increased Production and Decreased Prices, Withal Few Mistakes

OUR English contemporary, "The Engineer," in one of its leading articles, gives some illuminating information regarding the engineering achievements of the Ministry of Munitions in Great Britain. The story of the work of this department, it states, is in no mere conventional sense of the expression a romance of industry, and the future historian will probably date the beginnings of a new era in Great Britain as a manufacturing nation from the war tasks of the engineer and his allies in production. If what has happened in the diversion of ordinary peace activities to the manufacture of munitions, using that word in its broadest sense of constructing, equipping, and manning the many new factories which are now in operation, and of ridding the nation of the dependence for certain essential materials on foreign sources of supply, had been predicted when a beginning was made with what Dr. Addison modestly terms a "munition shop," even the most competent judges would probably have derided the idea that such manufacturing miracles were within the capacity of Great Britain. Yet the seemingly impossible has now been accomplished. Those who have read Dr. Addison's statement on the subject—engineers no less than the lay public—are filled with amazement at the results of the national effort to provide our forces in the field with the weapons without which human valor would have been in vain.

Range of Activities

Perhaps the two facts which emerge with sharper outlines than the rest from the mass of information presented by Dr. Addison are the extraordinary capacity for production in the factories now in operation and the wide range of activities over which the control of the ministry extends. It is not merely the manufacture of explosives, of shells and shell components, the supply of guns of all types, of grenades, bombs, specialized chemical apparatus, trench mortars, and other materials which fall within the ordinary category of munitions to-day; the ministry has had to deal with the supply of machine tools, scientific instruments, railway material, including locomotives, trucks, and track, road transport vehicles, "tanks," agricultural machinery, and aeroplanes, and to arrange for sea transport on a constantly increasing scale. Even this catalogue of activities does not exhaust the responsibilities of the ministry. Before prodigies in output could be accomplished it was necessary to take cognizance of many things. These included the supply, distribution, working up, and control of the various raw materials in the form of minerals and metals ,a work which has continued to grow in importance, and is giving gratifying proofs of the great potentialities of empire sources of supply. For example, the annual output of steel in Great Britain is being increased from seven to twelve million tons a year; the production of spelter is about to be doubled, while supplies of tungsten and aluminium from home sources are being put on a satisfactory basis.

Reducing Productive Costs

At the same time, although the main object with which the ministry was created was to obtain the necessary large supplies of munitions, irrespective of other considerations, it has been found possible to give attention to questions connected with productive costs, and thus to effect manufacturing economies of no mean order. To quote a single instance, the ministry is obtaining steel plates at less than half their cost in the United States, and a group of T. N. T. factories is producing explosives at a cost of 50 per cent. below the contract prices ruling when the factories were under construction. Then there is the labor question. Labor requirements have, of course, been on a stupendous scale. Even in the early days there was a need for hundreds of thousands of workers, and the demands for skilled, semi-skilled, and unskilled labor have been constantly increasing. It was only possible to solve this problem by undertaking what has proved to be a revolution of our industrial system. Trade union regulations and rules had perforce to be suspended, and a mass of semi-skilled and unskilled labor hitherto engaged in other branches of industry, or lacking previous experience of industrial life, had to be imported into munition works.

Few Mistakes

The greatest innovation of all has been the widespread employment of women, who now perform most of the machine work on shells, fuses, and trench warfare supplies, and large numbers of whom have been trained in aeroplane manufacture, in gun work, and in many other branches of industry. The wonder is not that the department, under this great stress, has made mistakes, for that it has done so is admitted even by its best friends, but that these mistakes have been so few, and, except during the recent strike, have left the output of materials of war, by which in the last resort the Ministry of Munitions must be judged, comparatively unaffected. Engineers at least have every reason to be proud of the story of their work as unfolded by Dr. Addison.

It is, however, not only the success which has been achieved in supplying the needs of the fighting forces which invests the work of the Ministry of Munitions with supreme interest, but the effect which its labors must have on the future of engineering. The experience which has been accumulated, the stimulus to production, the incentive to invention, the new spirit of self-reliance—these things are destined to have a profound effect on the industrial future of Great Britain. It is clearly impossible that we can ever go back to the methods of the past, with the yawning chasm between capital and labor, and when industry was content to grope its way in semi-darkness and leave the lamp of science flickering feebly on the shelf. Men who have shown of what they are capable will never return to the deliberate practice of incapacity. We have set up new standards and see our opportunities with a clearer vision.

Program of Western Trip of Secretary of C. S. C. E.

The following is Mr. Keith's schedule: Winnipeg, August 15; Regina, August 17; Moose Jaw (summer meeting of the Saskatchewan branch), August 18; Calgary, August 20; Edmonton, August 22; Victoria, August 29; Vancouver, August 31.

Manitoba's Permanent Bridge Building

Over Seventy Per Cent. of Those Built in 1916 Were Concrete or Steel—Details of Noteworthy Structures—Consideration for Style

By P. Burke Gaffney, B.E., B. Sc., A.M. Can. Soc C.E.*

During the season 1916 seventy-nine bridges were built under the supervision of the Good Roads Board in the Province of Manitoba. Of these forty-five were all concrete, eleven steel on concrete or masonry abutments, and the remainder timber. The majority of the permanent bridges were standard types, as developed in the Good Roads Department, of which the accompanying photograph of a 16 ft. span reinforced concrete bridge in the Municipality of Russell, and of a 30 ft. span steel I-beam bridge in the Municipality of Lorne are characteristic examples. The most noteworthy of the special structures are described below.

Design Specifications

The design loading for all types consists of an 18-ton road roller, 10 ft. between axles and 6 ft. between the central planes of the wheel, with 75 per cent. of the load carried on the rear pair of wheels, and followed by a uniform load of 400 tons per lineal foot. As an alternative, a load of 100 pounds per square foot of bridge floor, for spans up to 100 feet, and a proportional decrease for longer spans, is used. For steel bridges Cooper's 1909 specifications for highway bridges have been adopted. The working stresses per square inch used in concrete are as follows: Direct compression, 500 pounds; extreme fibre compression, due to bending in floor slabs, 600 pounds; in beams, 650 pounds; in arch ribs, dead plus live load, 650 pounds; in arch ribs, dead plus live loads plus temperature, 750 pounds. The range of temperature in arch ribs computations is generally assumed at 60 degrees F. The shear and bond stresses are proportional to the corresponding compressive stresses, according to the American Society of Civil Engineers' specifications.

Reinforcing steel is specified to consist of cold, twisted square bars of medium steel, having an ultimate strength of 55,000 to 65,000 pounds per square inch, and elastic limit of not less than one-half the ultimate strength, and a minimum elongation in 8 inches of 1,400,000 divided by the ultimate strength per cent.

A working stress of 16,000 pounds per square inch is used, and for triangle mesh in floor slabs a working stress of 20,000 pounds.

18 Ft. Roadway on Rural Bridges

All rural bridges are constructed with an 18 ft. clear roadway. The standard short-span concrete bridges are of the usual beam and slab design, and the details of their design call for no special comment. They are invariably of the U-abutment type, since it is considered almost impossible to reconcile, artistically, flaring wings and the comparatively heavy-looking balustrade which an all-concrete structure demands. A comparison between the short-span bridge illustrated here and similar structures with flaring wings, built elsewhere, will bring this point out with greater emphasis. The balustrades were cast monolithic with the bridge proper, a set of forms being constructed for the complete parapet. It was found extremely difficult to obtain a well-finished balustrade. The chief defects were warping of the forms, voids, rough and uneven surfaces, chipping when removing forms; and in the coming season it is proposed to construct premoulded balusters and railings in an endeavor to obviate these faults and to secure economy.

*Bridge Engineer, Good Roads Board, Manitoba.

Short Span Steel Bridges

Short-span steel bridges are constructed principally in localities where there is an abundance of field stone and "nigger-heads," and no good gravel for concrete. The abutments are then built of boulder stone masonry and the span of steel I-beams and channels. There are six I-beams and three pairs of channels in each span; the channels are placed back to back, with a timber nailing strip between, to which the floor timbers are spiked. The flooring consists of 3 in. timbers the full

A standard type of steel I-beam bridge.—A 30-ft. span in the Municipality of Lorne

width of the bridge and 2 in. timbers 14 ft wide, to provide a wearing surface. The railing is made up of expanded metal sheets held between pairs of angles, and constitutes a very rigid and safe parapet. The only field connections in the bridge are the diaphragms to beams, and the handrail to exterior channels. Bolts are just as effective as rivets in making these connections, and permit inexperienced laborers to assemble this type of bridge equally as well as high-priced erecters.

The following special structures are of interest:

ARCH OVER THE WHITE MUD RIVER, MUNICIPALITY OF LANSDOWNE.

This structure was the first open spandrel arch to be constructed in the Province of Manitoba, and, in a sense, is epoch-making in the annals of the province. Formerly the dwellers in the plains of Manitoba were pledged by their environment to rank utilitarianism, and the cult of aesthetics found no place in their conceptions; but now that untrammelled nature is broken to the harness they have time to put their house in order. The habits of a lifetime cannot be changed in a moment, and one of the most difficult tasks with which the Good Roads Board has been confronted is the inculcation of the notion of ultimate economy in permanent construction, and of the moral and intellectual uplift in the appreciation of architectural beauty. It is greatly to the credit of the Council of the Municipality of Lansdowne to have sanctioned the construction of

The White Mud River arch bridge is the first of its kind in Manitoba and a type well suited to the needs of the province

this bridge, a type unknown to their experience, and their progressiveness has done much to lighten the labors of the Good Roads Board in this respect, for where one leads, others will follow.

A Leader in Bridge Styles

A structure to be architecturally correct must be in keeping with its surroundings, and hence the principles governing the treatment of a bridge on a rural road are a certain ruggedness of outline, a lack of detail and ornamentation, a slight accentuation of the massiveness of the prominent features, yet all the minor parts welding into one harmonious whole. The accompanying illustration of the Lansdowne arch portrays the practical application of these principles.

The road upon which the bridge is situated is one of the most important in the district, serving a wide area south of the town of Arden, and subjected to considerable traffic between Arden and Neepawa. The site is close to the junction of the Edrans Road and the Arden Ridge Road, both of which are natural roads, much used by tourists. The old bridge was a pile structure, in a very dilapidated condition, and at the foot of a steep hill. The new bridge was located about one hundred feet east, in order to obtain a better approach from the south.

Two-ribbed Spandrel Arch Type

The new bridge is a two-ribbed open spandrel arch, with approach spans. The arch is 55 ft. clear span, 9 ft. rise above springings; the ribs, which are segmental, are 4 ft. wide, 18 inches deep at the crown, reinforced with sixteen 1⅛ in. square twisted bars; the floor system, of the beam and slab type, is carried to the arch rings by spandrel columns. The approaches are 17 ft. spans, supported by columns, allowing the earth to spill through and find its natural slope, thus eliminating expensive retaining walls. The bridge is 90 ft. long over all, and the height from roadway to bed of stream is 18 ft.; there are 80 piles, driven to a penetration of 14 ft., underneath the footings. The bridge was built by the Brown Construction Company, under contract, and the cost was as follows:

Excavation, 431 cu. yds. at $1.50	$ 646.50
*Piles (supplied by the municipality), 1,536 lin. ft. at 25c	384.00
Reinforcing steel, 33,740 lbs. at 3¾c	1,263.75
Concrete, 272.7 cu. yds. at $10	2,727.00
Cement, 435¾ bbls. at $2.60	1,132.95
	$6,154.20
Grading approaches	$2,578.13
Inspection and testing materials, etc.	766.58
Total	$9,498.91

*Includes temporary piles for falsework.

REINFORCED CONCRETE ARCH OVER McKINNON'S RAVINE, MUNICIPALITY OF RIVERSIDE

About one-half mile north of the town of Margaret the road crosses this deep ravine. At both ends is a 12 ft. cut, and through the ravine a fill reaching a maximum height of 20 ft. at the centre and approached by steep grades. A waterway was provided by a 6 ft. x 8 ft. concrete culvert, but in the spring of 1916 the flow proved greater than the capacity of the culvert; the

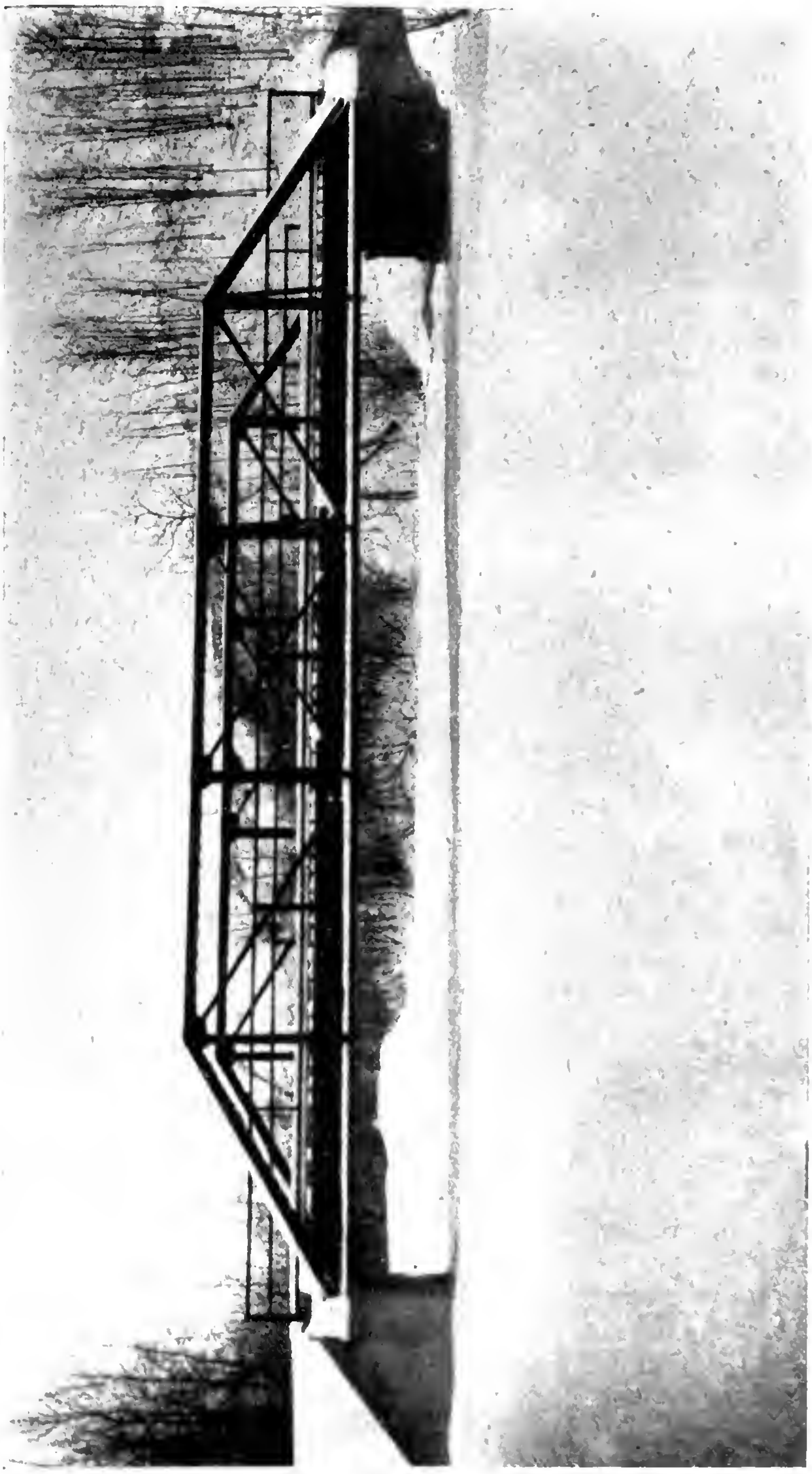
The bridge over McKinnon's Ravine is a two-ribbed open spandrel arch of reinforced concrete

water rose above and flowed over the grade, and a portion of the grade 78 ft. wide was washed away. The culvert was uninjured. The situation was one demanding a permanent structure of sufficient capacity to provide for whatever contingency might arise. Any construction of a temporary nature would have been simply money wasted, since the power developed by a 20 ft. head of water is enormous. The waterway provided had to be large enough to prevent the existence of such a head, and the portions of the structure subject

Corbett's bridge, a 126 ft. span steel through-truss bridge over Swan River, Manitoba

Typical examples of permanent bridges replacing the wor

A standard 16 ft. reinforced concrete design—This one is in Russell municipality

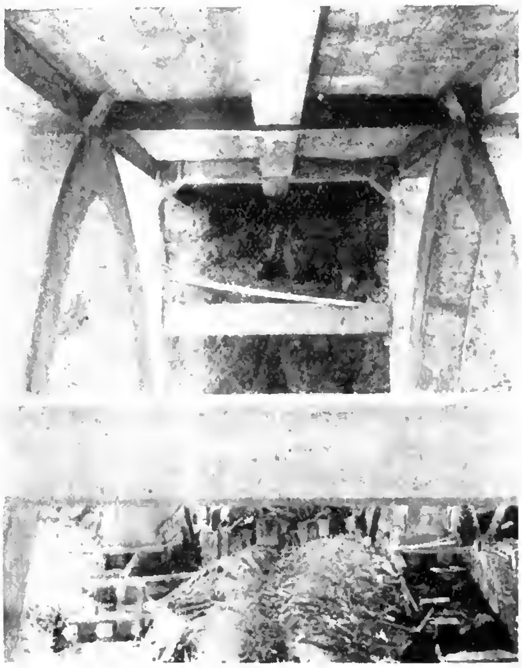


A 75 ft. bridge over Roaring River, Swan River Municipality, Manitoba

ber structures common to the rural districts of Manitoba to submersion had to be sufficiently strong as to be unaffected by floating objects, such as ice or logs.

Municipality Carried Out the Work

Alternative plans were prepared—one for a steel cantilever, using the old culvert as a pier, and one for a reinforced concrete arch, with approaches—and bids were called for on this basis. The prices submitted were slightly in favor of the concrete structure, but the municipality made no award, on the grounds that the prices were too high, and determined to carry out the work by local labor, deciding on the arch construction.



McKinnon's bridge from below to show arch ribs and deck

The structure consists of a two-ribbed open spandrel arch, carrying a concrete floor system, with reinforced concrete approaches carried on pedestals. The original design showed the ends of the approaches resting on concrete piles; however, the start of construction had been delayed so long that it was deemed inexpedient to waste the further thirty days demanded by the specifications for the curing of the piles, and pedestals 24 in. square standing on footings 5 ft. square were substituted. Excavation was made for these pedestals by cutting into the fill from the sides. The fill had been brought up gradually during many years, and the top of each successive roadway could be distinctly traced in the section. In consequence, the material was thoroughly consolidated, and stood up sufficiently long for concreting to be completed without any timbering.

Construction Details

The arch has a clear span of 30 ft. and a rise of 15 ft. above springings; the arch ribs are 24 in. x 27 in. at the crown and 24 in. x 57 in. at the springings, reinforced with fourteen 7/8 in. square twisted rods. The foundation bed was hard and compact, and consisted of gravel cemented with a stiff clay. The ribs were tied across the bottom by means of twelve 3 in. x 3 in. x 5/16 in. angles bedded in concrete, thus doing away with the necessity of providing heavy abutments to take the thrust and at the same time affording an unyielding footing for the arch centering during construction. Each arch rib was concreted from springings in one continuous pouring. The floor system is the usual beam and slab type, reinforced with two layers of No. 32 triangle mesh. The mesh was delivered on the job in rools, cut into the required length by means of a blacksmith's nippers and bent to shape by laying the mesh across a 4 in. x 4 in. angle, with its legs upstanding at an angle of 45 degrees with the vertical, and striking each strand between the legs of the angle with a four-pound hammer; the cutting and bending of 3,600 square feet was done by a blacksmith and his helper in a day and a half.

Old Culvert Left in Position

The approaches are 20 ft. clear span and the overall length of the bridge is 86 ft.; the height from floor level to bottom of footing is 24 ft. The old culvert was left in position, as it was considered that the cost of removing it would be considerable and no material advantage would be gained thereby. The municipality purchased all material and appointed a foreman recommended by the Good Roads Board to carry out the work. Gravel was hauled about 2½ miles to the site, screened and regraded. Work was not started until late in September, and the scarcity of labor at this period and inclement weather precluded the possibility of completing the bridge before freeze-up; the centering was, therefore, left in place all winter, and the construction of the balustrade left until the spring of this year. The bridge is now complete. The following are the details of quantity and cost:

	Quantity.
Excavation......	325 cu. yds.
Concrete........	226 cu. yds.
Cement.........	289 bbls.
Steel............	21,080 lbs.

	Costs.
Labor	$2,424.40
Cement	870.24
Gravel	364.50
Steel	1,327.30
Lumber.......	533.08
Freight, inspection, etc.	141.15
Total	$5,660.67

VALLEY RIVER BRIDGE, MUNICIPALITY OF DAUPHIN

A survey was made for the bridge over the Valley River, in the Municipality of Dauphin, in 1915. The old bridge was a "Grafton truss," and was on a skew

Valley River bridge—110 ft. steel truss with two 25 ft. concrete approach spans with the road allowance. The road upon which the structure is situated is the main road north from Dauphin. It was decided, following the policy of good roads construction, to build the bridge parallel to the road allowance, and with this end in view plans were prepared for a 110 ft. span steel truss spanning the river, with two steel I-beam approach spans on one end, all on concrete foundations. Construction was postponed until 1916, and, in view of the advancing price of steel, it was decided to make the approaches of all concrete construction, thereby effecting a considerable saving.

Work Done By Contract

The work was done by contract, but the gravel was supplied by the municipality, having been hauled on sleighs about 1½ miles to the site the previous winter. Work was started in August and finished late in November. The structure as completed consists of 110 ft. span Pratt truss, standard design, resting on the south end on a reinforced concrete abutment, and at the north end on a solid concrete pier; the two approach spans at the north end are of standard 25 ft. span reinforced concrete bridge construction, founded on piers. Originally it was intended that the abutments should be carried on piles, but a good gravel foundation bed rendered this unnecessary. No unusual features developed during the construction. The contract for the substructure and approaches was let to E. E. Pilgrim, of Dauphin, and the contract for the steel superstructure to L. O. Beam, of Saskatoon. Subjoined are the detailed costs:

Substructure Contract

South Abutment and Approach Spans

Excavation, 227 cu. yds. at $1.75	$ 397.25
Concrete, 136.4 cu. yds. at $12.50	1,705.00
Steel reinforcing, 12,469 lbs. at 4½c	561.10
Timber, 432 f.b.m. at $35 per M.	15.12
Cost of south abutment and approach spans	$2,678.47

Concrete Pier

Excavation, 50 cu. yds. at $2	$ 100.00
Concrete, 42 cu. yds. at $8.50	357.00
Extras	98.13
Total substructure	$3,233.60

Superstructure Contract

Steel truss (approx. 50 tons), at	$ 6,630.00
Timber deck, 11,045 f.b.m. at $34	375.46
Total superstructure	$7,005.46
Total cost of contract work	$10,239.06
Inspection and testing materials	403.07
Temporary crossing and road diversion	114.65
Sundries etc., advertising, etc.	81.65
Hauling gravel	212.80
Total cost of brdge	$11,051.23

All work is carried out according to the design and specification, and under the supervision of the Good Roads Board, of which Archibald McGillivray, A. M. Can. Soc. C. E., as Highway Commissioner, is ex-officio chairman; the other members of the board are T. R. Deacon, M. Can. Soc. C. E., and Col. C. E. Ivens, reeve, Municipality of Wallace; M. A. Lyons, A. M. Can. Soc. C. E., is chief engineer.

New Members of Canadian Society of Civil Engineers

The following have been elected members, associates, etc., of the Canadian Society of Civil Engineers:

Members—Mr. E. G. de Coriolis, consulting chemical engineer, Arthur D. Little, Ltd., Montreal; Mr. G. R. Kendall, assistant inspector of steel, Imperial Munitions Board, Montreal; Mr. A. T. C. McMaster, designing engineer on the Calabogie power plant for Kerry & Chace, Ltd., Toronto.

Associate members — Mr. C. C. Cronk, Regina, bridge inspector, Board of Highway Commissioners, Saskatchewan Government, and assistant on bridge and road construction and coal investigation; Mr. K. N. Crowther, Qu'Appelle, Sask., Dominion and Saskatchewan land surveyor; Mr. E. N. Horsey, Victoria, B.C., resident engineer for British Columbia Electric Railway Company, in charge of maintenance of way and suburban lines, and construction and maintenance engineer of various properties of British Columbia Electric Railway and subsidiary companies on Vancouver Island; Mr. W. J. Johnston, Ottawa, in charge of surveys for Dominion Government in British Columbia; Mr. E. H. Maple, officer in charge of construction of Dominion Arsenal, Lindsay, Ont., for the Militia Department; Mr. C. A. Mullen, director of paving department, Milton Hersey Company, Ltd., Montreal; Mr. J. F. Rhodes, Montreal, manager of publicity and advertising, in charge of technical information and publicity re use of portland cement in construction, Canada Cement Company; Mr. C. Varcoe, district engineer of the Water Rights Branch, with headquarters at Kamloops, B.C.

Transferred from associate member to member—Mr. R. Fowler, municipal engineer, Oak Bay, Minn.; Mr. C. S. L. Hertzberg, member of the firm of James, Loudon & Hertzberg, Toronto, and now lieutenant 7th Field Company, Canadian Engineers, doing engineering work at the front; Mr. J. T. Johnson, Ottawa, hydraulic engineer and chief hydraulic engineer in charge of all field power and storage investigations carried on in the West by the Dominion Water Power Branch.

Transferred from junior to associate member—Mr. S. A. Cummiford, Toronto, assistant to chief engineer, Toronto and Hamilton Highway Commission; Mr. H. M. Goodman, Montreal, division engineer, Melrose Avenue tunnel, city of Montreal; Mr. R. J. L. Savary, hydraulic engineer and surveyor with the Quebec Streams Commission, Montreal.

Transferred from student to associate member—Mr. B. Grand Mont, senior assistant engineer on construction of new Lauzon drydock, Quebec; Mr. F. S. Rutherford, travelling examiner of component parts, Imperial Munitions Board, London, Ont.

Junior—Mr. C. V. Putman, Ottawa Waterworks Department, construction engineer in charge of all construction, water mains, and redistribution system.

Inspection of Asphalt Paving

The Milton Hersey Company, Montreal, Winnipeg, and New York, are rendering a specialized service in connection with asphalt and tar road and street paving work to the Quebec Government, the city of Quebec, the city of Montreal, the city of Woodstock, Ont., and others. They are to have charge, as specialists, of the asphalt paving work on the Quebec-Montreal highway. This work is expected to start in the very near future, the asphalt paving plant for making the surface mixture being already in process of erection. The service that this company renders, which is charged for, in most cases, on a square yard flat rate basis, includes consultations, reports on proposed materials and mixtures of materials, reports on materials as delivered, investigations when necessary, and routine inspection and testing, including the services of trained inspectors stationed at the work. Mr. Paul E. Mercier, C.E., chief engineer of the city of Montreal, first availed himself of this expert service a little over a year ago, and to-day he recommends such a service to all cities doing asphalt work. The company have a staff of specialists specially engaged to take care of the different branches of this work, some of whom are men of extensive practical experience and others men of high technical training. Mr. Charles A. Mullen is the director of the paving department and Mr. Walter C. Adams, B.A.Sc., is chemical engineer.

Toronto's New Pumping Unit Gives Record Duty Under Test

A TEST conducted on March 8 by Professor R. W. Angus of the University of Toronto on one of the new pumping units installed in the John Street waterworks station indicates a duty eclipsing that of any previously recorded. The unit under test was one of two installed early in 1917, consisting of a steam turbine driving through gears two 24-inch centrifugal pumps. The capacity was 24,000,000 gallons per day. The two pumps of the unit are single-stage, double-suction types, connected in series. The condenser has 1,300 square feet area of 1-inch brass tubes, and passes all the water received by the pumps. The air-pump is of wet vacuum type, and a chain-driven triplex pump delivers the contents of the condenser from the hot well to boilers. The discharge of the first pump was used for cooling bearings and oil tank.

The De Laval Steam Turbine Company, manufacturers, guaranteed a capacity of 24,000,000 imperial gallons per 24 hours, against a pressure of 107 pounds per square inch, measured between suction and discharge mains. A duty of 141.5 million foot pounds per 1,000 pounds steam was also guaranteed, a penalty being fixed of $2,500 per million foot pounds below the guarantee and a bonus of $1,500 per million foot pounds above.

The results of the test are given in the accompanying table, and show a duty of 153.92 million foot pounds per 1,000 pounds of steam, no allowance being made for friction or added velocity head. The manufacturers calculate the duty for the bare machine at 160.5 million foot pounds per 1,000 pounds of steam, taking into account the friction and added velocity head in the pump approach.

Summarized Results of Toronto Pump Test, March 8, 1917.

Average boiler pressure, lb. per sq. in., gauge	148.4
Steam pressure at turbine, lb. per sq. in., gauge	144.6
Moisture in steam at turbine, percentage	0.35
Vacuum in exhaust chamber, in.	28.69
Barometer reading, in.	29.43
Vacuum referred to 30 in. barometer	29.26
Net pressure produced by pump, lb. per sq. in.	107.18
Discharge as measured by Venturi tube and mercury column, million gal. per 24 hr.	25.1
Corresponding water horse-power	1,306.
Steam used per water horse-power, lb.	12.88
Duty in million foot-pounds per 1,000 lb. of steam	153.92

Eastern Capitalists Interested in B. C.

MR. E. J. LEVESON, British Columbia representative of the Hennebique Systems, with offices in the Dominion Building, Vancouver, returned recently from an extended business trip to New York, Montreal, Toronto, Ottawa, Winnipeg, Regina, and Calgary, in the interests of the company. While in New York he met many of the moneyed men of Wall Street, who questioned him very closely as to the opportunities for investment in British Columbia. They seemed to be fairly well informed relative to the prosperity now attending the lumbering and mining industries, and concerning the former they were more optimistic than some of our Coast manufacturers, being generally of the opinion that there is a long period ahead, in which a strong demand for lumber and high prices will be marked characteristics. Generally speaking, the New Yorkers appeared to be impressed with the opportunities offering in British agents on the ground spying out likely propositions. With some of Mr. Leveson's interviewers it seemed to be a matter for surprise that the known resources of the province in timber, minerals, fish, agricultural and fruit lands, had not already resulted in quadrupling the present population, but they admitted that, following the close of the war, there was bound to be a steady stream of new settlers, with the result that big opportunities for money-making would open up. While in Toronto and Ottawa, Mr. Leveson was questioned closely concerning the Coast pulp and paper industry and the markets opening up in Australia, New Zealand, and the Orient. Mr. Leveson, it may be explained, was for a number of years in charge of the Pearson oil interests in Mexico, and through his connection with that powerful organization has more than a speaking acquaintance with many of the leading financiers of Europe and America.

Emulsified Concrete Makes Repairs to Concrete Roads

THE use of emulsified asphalt for maintaining concrete roads is recommended by H. B. Bushnell, division engineer, Illinois State Highway Department. This method has the advantage that no heating kettle is required, and that the work can be done even when the surface of the pavement is wet, there being no necessity for having the sides of the crack dry in order to make the asphalt adhere to it.

About one gallon of emulsified asphalt, thinned with a pint of water, is mixed with a cubic foot of stone chips graded, for large cracks, from three-fourths of an inch down to dust, and for the smaller cracks from a half or three-eights of an inch down. Small pebbles and sand have also been used with good results. Experience has shown that the aggregate should be so graded as to reduce the voids to a minimum.

The asphalt is poured upon the aggregate and the whole thoroughly turned by hand. The mixture is then poured into the crack and well tamped to insure against settlement.

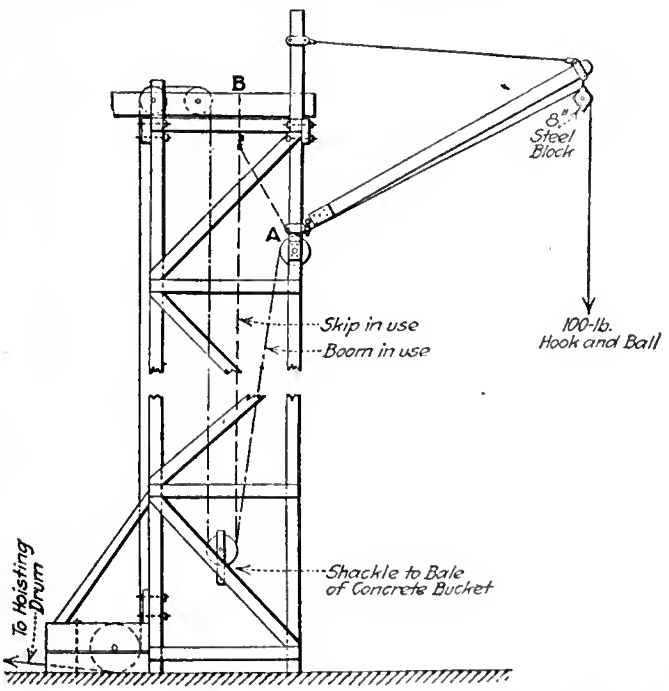
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Quick Change Arrangement Enables Single Line to Handle Bucket and Boom

OFTEN in reinforced concrete building construction where a tower is used it is not possible for various reasons to install two hoists, and the same line is used both to handle the concrete bucket and the boom rigged on the tower for handling reinforcing. The principal drawback to this method is the length of time it takes to change the cable from the bucket to the boom and back again.

The scheme shown in the sketch, which is outlined by G. E. Harr in Engineering News-Record, was used



A single hoist line operates bucket and derrick boom and can be changed from one to the other in 15 minutes.

on a building recently built by the Turner Contruction Company. The method was to reave a single cable through the bucket and then through the boom, leaving it in this position all the time. When the boom was to be used, the bucket could be held down by sticking a 4 x 6 in. timber through the hoist tower. When the bucket had to be hoisted, a dead end was made in the line at the top of the tower by taking a bight in the cable at A, throwing a turn over the header block at B, and fastening it with two clips. When this is done and the 4 x 6 block taken out of the base of the tower, the rigging is ready for hoisting concrete.

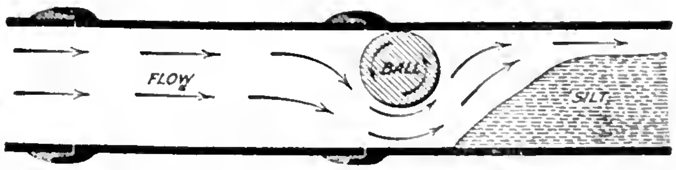
This change was frequently made in ten minutes, and never took longer than fifteen minutes. When changing the rig from hoisting concrete to shape for using the boom, one man takes off the cable slips and another puts the 4 x 6 over the bucket at the bottom of the tower. This operation never took more than five minutes, and once the change was made in two. This time is, of course, much less than that required for the old way of rigging and unrigging the boom or bucket for each change.

Zinc Balls Flushed Through Clogged Sewer Pipes Remove Silt

SOME years ago a pipe sewer system was constructed under the supervision of E. B. Shifley, city engineer, Owensboro, Ky. It was stipulated in the specifications that a ball 2 in. smaller than the bore of the pipe should pass through without lodging. In making this test on a certain section of sewer the ball became lodged, and had to be flushed to the manhole below. When the ball appeared in the manhole it was found carrying a half-brick before it. Appreciating the significance of this accidental discovery, Mr. Shifley applied this principle to the cleaning of sewers, with excellent results. It is not successful where roots are encountered, but where silt and debris have collected in the sewer—due to the absence of flush tanks and catchbasins, or where the latter have been allowed to fill—this plan has been found to be cheaper than the drag or bucket method, and entirely satisfactory.

When a sewer is flushed without a ball ahead of the stream of water, the sand or silt is pushed forward by the flow of water and the outlet is choked, thereby causing the water to back up and so lose its nozzle pressure; when a ball is used ahead of the water, the outlet is kept partly open, thus utilizing the pressure.

If the sewer is badly choked, a ball 5 to 10 inches smaller than the diameter of the pipe is placed in the sewer at the manhole and a stream of water applied



Clogged sewers easily cleaned by flushing through zinc balls.

behind the ball until it appears at the manhole below; the deposit is removed from the manhole, and a larger ball is then started from the manhole above and carried through as before. This plan is repeated until the sewer is clean. To insure a clean sewer the last ball to pass through should be 2 in. smaller than the sewer. Where sewers are not badly choked, the first ball may be large, the size depending on the condition of the sewer. The ball should float, and should be as light as is consistent with strength. Those used with best results are hollow and made of two thicknesses of No. 24 gauge zinc, the seams being set at right angles. The sizes run from 4 to 22 inches. Wooden balls have not proved satisfactory.

A fork or screen with a sandbag directly in front of it should be placed at the inlet end of the lower manhole. This is to prevent the ball, together with the silt expelled from the cleaned sewer, from escaping into the next section of sewer. A line of sewer should, of course, be cleaned in sections, beginning at the upper manhole.

Last year an abandoned sewer of 15 in. diameter was found to be almost filled with silt, there being a space of about 2 in. only at the top to allow passage of water. In cleaning this a 4-in. ball was first used and last a 13-in. ball. With the aid of these balls five cubic yards of sand were removed from this sewer in four hours.

The accompanying sketch shows the position of the ball and its action.

Pneumatic Delivery on Twin Peaks Tunnel Chutes Concrete into Forms at a Mile a Minute

THE work of lining the Twin Peaks tunnel at San Francisco with concrete has been expedited by using the pneumatic method for delivering the mix, as well as collapsible steel forms designed especially for this work. The forms have made it possible to carry out the work so that both walls and the ceiling slab could be poured simultaneously. The wall footings were poured first, and after the walls and ceiling slab were poured the arch was put in in a third operation. Where an invert was required it was poured in a fourth operation. The following description of the pneumatic placing of the concrete appears in Engineering News-Record:

Concreting was carried on from both ends of the tunnel, the air for all operations being compressed at the central power plant at Laguna Honda station. This compressor plant consisted of two 750 cubic foot and one 1,100 cubic foot two-stage compressors, run by two 100 h.p. and one 150 h.p. motors respectively. From this plant air was conveyed to the east portal through a 6-inch pipe, 7,000 feet long, and delivered into a cylindrical receiver or balancing reservoir, 6 x 10 feet in size.

Mixing Without a Mixer

From this receiver the air passed through a 4-in. pipe to the mixing chamber, located underground and just above the ceiling slab of the tunnel. This chamber was a steel cylinder 3 ft. in diameter and 5 ft. high, with a conical bottom terminating in an 8-in. elbow leading to the delivery pipe. The materials were admitted to this mixing chamber from a charging hopper immediately above the mixer, where the aggregate was measured, all the materials coming into the hopper by gravity flow from bunkers above.

A crew of three men was stationed at the mixing chamber, two operating the chutes leading into the measuring hopper and one man operating the levers admitting charges to the mixing chamber and controlling the compressed air.

When the dry batch was ready in the hopper a door in the top of the mixing chamber was opened and the charge dropped in together with a measured quantity of water. The charging door was then closed by the air-operated piston, and a valve admitted compressed air through two 2-in. pipes at the back of the elbow below the mixing chamber. These pipes directed their jets horizontally into the elbow and on into the delivery pipe, their function being to mix the batch and start it along the delivery line. Immediately after admitting air at the back of the elbow the main valve was opened, letting air in through four 2-in. pipes at the top of the mixing chamber. This put a pressure directly behind the batch and kept it moving through the line.

Experience in Pneumatic Delivery

After some experience with the long delivery line, it was found that the air supply could be conserved by getting about three batches into the line before keeping the pressure on long enough to send the concrete clear through to the point of delivery. Under this method a batch was put into the mixing chamber and then advanced a distance of several hundred feet in the deilvery pipe by the pressure from the main air line. The pressure was then cut off and another batch admitted in the same way. After the third batch had been put in the line the air pressure was kept on until the pressure gauge on the delivery line approached zero, indicating that the charge had been delivered at the far end.

The average speed of a single charge going through the line was reported as about a mile a minute. The speed of operation of the system was found to depend upon the length of the pipe line and the skill of the operator. The usual rate, using 16 cubic foot batches, varied from 70 batches per hour at 300 feet to 30 batches at 4,000 feet. Efficiency of the system was found to be largely dependent upon the operator.

If the charge is delivered at the high rate of speed at which it is transmitted it strikes a very considerable blow at the point of delivery. To take up this shock and wear, a hopper with renewable steel plates was secured to the tunnel timbers opposite the end of the delivery pipe. After expending its force on these baffle plates the concrete flowed in gravity chutes into the forms. By cutting off the air pressure at the proper moment the operator could deliver the batch without the shock that accompanies delivery under full pressure. In the case of the arch, where gravity flow was not possible, concrete was shot directly into place, lengths of pipe being removed from the end of the line as the space was filled.

From one end the delivery pipe was laid on a 3 per cent downgrade, and from the other end the line ran up a 3 per cent. grade until the elevation above the mixing chamber was 111 ft. The delivery of concrete on the upgrade required more air, but involved only a small part of the trouble with clogging that occurred on the downgrade. The operators expressed an opinion that this difference was due to the tendency of wet concrete to flow downgrade. On the downgrade delivery the action of gravity would tend to spread the batch and let the air pass over it, while in the upgrade delivery gravity acted on the batch in one direction and air pressure in the other, thus tending to hold the charge together.

Except for the elbow immediately under the mixing chamber, there were practically no bends or angles in the pipe. The pipe used was 8 in. steel casing in 12 and 20 ft. lengths, with flanged joints. It is notable that a large percentage of the wear occurred at joints. As leaks appeared, indicating worn spots in the pipe, patches were clamped on until such time as the leakage became excessive. If the hole occurred at the joint a short section would be cut off and the end of the pipe heated and again flanged so that it could be put back in service.

Water Powers of Northern Alberta and Saskatchewan

In the most northerly parts of the Provinces of Alberta and Saskatchewan there are a number of very large water-powers available which, however, are too far removed from transportation facilities to be very valuable as yet. Lake Athabaska lies across the border line, between Alberta and Saskatchewan. It is drained by the Slave River, which empties into Great Slave Lake. The latter body of water is drained by the Great Mackenzie River, which flows in a northwesterly direction through the district known as the "Northwest Territories."

The Peace River

Peace River is formed by the junction of the Finlay and Parsnip Rivers, in the Province of British Columbia. It flows in a general northeasterly direction and empties into Lake Athabasca. Its total length from the source of its principal branch is 900 miles.

The Peace River has a maximum discharge, measured in the month of July, 1915, of 338,850 second feet and a minimum, measured in December of the same year, of 10,250 second feet. The largest estimated water-power is at Peace Canon Rapids, where, in a length of 18 miles following the river, 11 miles across portage, there is a fall of 225 feet. Peace River Canon is situated in British Columbia, just outside of the western boundary of the Peace River block. The descent in the canon is fairly uniform, except near the head, where there is a fall of approximately 25 feet in half a mile. At the narrowest point the distance from bank to bank is only 200 feet. On a basis of 11,000 second feet flow, the available water-power is estimated at 282,000 h.p.

At Vermilion Falls and Rapid there is a descent of 26 feet in a distance of a mile and three-quarters. The Commission of Conservation report estimates that the low-water flow during the open season is 24,000 second feet and the available horse-power 71,000.

There is also a rapid falling eight feet over a distance of a mile at Boyer, or Little Rapid, situated less than 100 miles from Lake Athabaska.

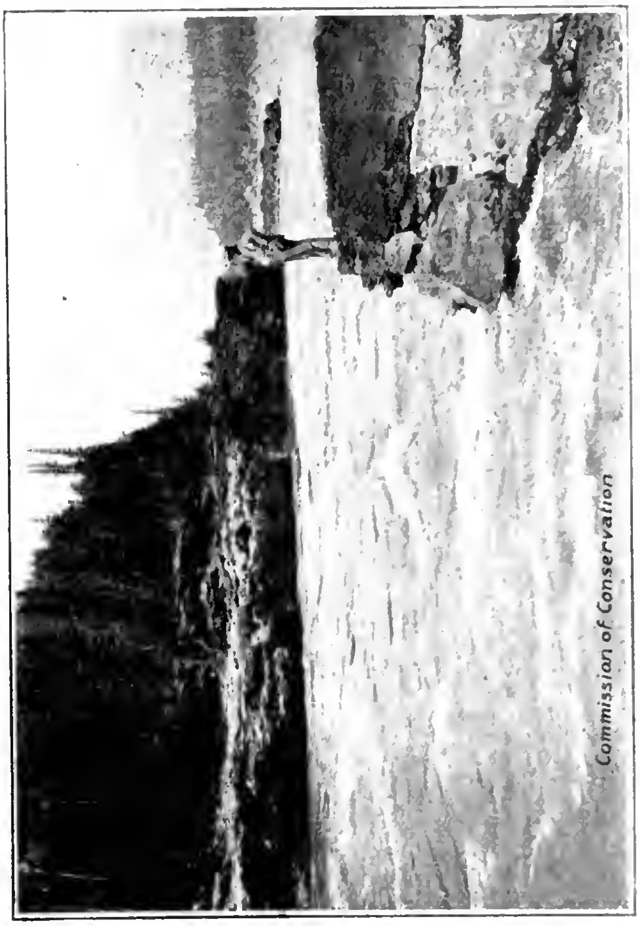
Athabaska River

The Athabaska rises in the watershed range of the Rocky Mountains, close to the boundary line between British Columbia and Alberta, and flows in a northeasterly direction into Lake Athabaska. Its total length is approximately 780 miles. Throughout this distance there are a number of falls, roughly estimated at 20, varying in height from 16 to 80 feet. The estimated low-water flow during the open season is placed by the Commission of Conservation report at 11,500, and on this basis there is an available horse-power of approximately 400,000, the largest of which is Grand Rapid, with 67,000 h.p. Four others are estimated at 36,500, 36,000, 32,500, and 26,000.

A number of tributaries add to the volume of the Athabaska River as it approaches the lake, but the water-powers on these rivers are not important. Five rapids listed on the Clearwater River with heads up to 41 feet give a total of 15,000 h.p. The Lesser Slave River, also with five estimated rapids, give a total of about 10,000 h.p. Stony River, with 75 foot fall and 200 second feet capacity, gives an estimated 1,700 horse-power.

Black River

The Black River rises in Wollaston Lake and flows west by north to Lake Athabaska. There are a number of falls and rapids of considerable height, one rapid having a 160-foot descent in two miles, and another 120 feet in three miles and



Peace River—Head of Peace River Canon

Slave River—One of the Fort Smith Rapids a half. The estimated low-water flow is estimated near the mouth at 5,900 second feet and the largest water-power at 107,000 h.p. The total power on this river is approximately 250,000 h.p.

Wollaston Lake, situated in the north-east corner of the Province of Saskatchewan, is fed by the Geikie River, on which there are a number of falls and rapids, varying in height from 45 feet down. The estimated low-water flow near the mouth of the Geikie is 3,200 feet, and the estimated power available during the open season totals approximately 45,000 horse-power.

Slave River

The waters of Lake Athabaska, which is fed by the Black, Athabaska, and Peace Rivers, as well as a number of smaller streams, are emptied by means of the Slave River into Great Slave Lake. The estimated low-water flow during the open season on the Slave River is 70,600 second feet. There are five rapids, giving heads respectively of 13, 10, 25, 42, and 27 feet. The length of the Slave is approximately 290 miles. The horse-power available at the five falls works out at 104,000, 80,000, 200,000, 336,000, and 216,000, or a total of 936,000 h.p.

The Northwest Territory

A considerable number of falls throughout the Yukon and Northwest Territories have been measured, but no reliable figures are available as to the capacity of the rivers. Falls vary in height from 250 feet down, with a total of 76 listed. Two water-powers in the Yukon district have been partly developed—one on Twelve-Mile River, where there is a fall of 710 feet, but only 2,700 h.p. has been utilized by the Yukon Gold Company. The Canadian Klondike Power Company has developed 10,000 h.p. on the north part of the Klondike River, where a head of 228 feet is available.

Trade Publication

Practical Road Building—by Charles E. Foote; $1.25 net; David McKay, publisher, Philadelphia. The primary purpose of the author has been to present a work on practical road-building which will give the greatest amount of information in the plainest language and without the use of technical terms. In its preparation the fullest possible use has been made of all technical information contained in engineering magazines, technical papers and addresses, and reports of various societies, the meat of which has been turned into practical and intelligent form for the non-technical reader. It is a book for the man who has not the time to make a study of all the literature on this subject and yet who requires a working knowledge for immediate use. It will be valuable to engineers, superintendents, and foremen, as well as municipal officers who may be interested in the building and maintenance of better roads.

Mainly Constructional

East and West—From Coast to Coast

The Toronto City Council have appropriated $5,000 for improving the condition of the North Yonge Street road.

Steel and wooden vessels to the value of $27,000,000 are at present under construction, or contracted for, on the Pacific Coast.

A smelter and nickel refinery is to be erected at Sudbury, Ont., by the recently-formed British America Nickel Corporation, a $20,000,000 concern, in which the British Government is the principal stockholder. It is anticipated the plant will cost about $6,000,000, and in two years' time 6,000 tons of nickel will be produced annually for the British Government.

At a recent meeting of the Town Council of Orillia, Ont., it was decided to submit by-laws for an addition to the Orillia Hospital, costing $25,000, and for paving work in the town, costing $100,000.

The Imperial Munitions Board are constructing another building on Wallace Avenue, Toronto, for the construction of aeroplanes. It will be of the usual type with galvanized iron sides, and will house 250 workmen.

Preparations are being completed by the Canadian Pacific Railway for the construction of two reinforced concrete bridges on the line between North Toronto and Leaside. Each bridge is to be 386 feet long and of the most modern construction.

The building permits in Montreal for July numbered 163, value $877,195, as compared with 221 in July, 1916, value $545,870. The value of permits from January 1 to July 31, 1917, is $3,311,539, as compared with $2,980,214 for the same period in 1916

The building permits in London, Ont., for the month of July numbered 75, value $75,030, as compared with 101, value $214,020, for the same month last year. The total for the present year to the end of July is $484,180, and for the same period last year $584,730.

The Pere Marquette officials have closed a deal for the purchase of six lots in Sarnia of what is known as the old Chain Company's property, owned by Montreal capitalists. The property is situated on Clifford Street, and it is the intention of the Pere Marquette to erect a new depot on the newly-acquired site. The old depot, which is situated west of the Imperial Oil Company's plant, will be torn down.

A large drydock recently constructed for the Toronto Drydock Company has arrived in Toronto from Sturgeon Bay, Wis., being towed almost 2,000 miles in 19 days, via Green Bay, Sturgeon Bay Canal, Lake Michigan, Lake Huron, St. Clair River, Lake Erie, and Lake Ontario. Two tugs were used, which alternately sped to the nearest port to coal up, thus saving unnecessary delays. Toronto has been without a very much needed drydock for many years.

City Architect Pearse, of Toronto, reports a cheerful outlook in the building trade. For the first seven months of the year permits were issued for new buildings of the approximate value of $4,087,782, as compared with $3,260,059 in the corresponding period last year, an increase of $827,723. In July, 425 permits were issued for new buildings, to cost $762,000, as compared with 352 permits for buildings, to cost $575,750, issued in July, 1916. Permits were issued early this month for new buildings of the approximate value of $93,000, which included a five-storey brick warehouse on Wellington Street West, to cost $65,000; the balance represents the cost of six new dwellings.

Personals

Mr. Melville P. White has been appointed manager of works for the Canadian Allis-Chalmers, Ltd.

Mr. A. R. Roberts, formerly representing the Cement Gun Company, Allentown, Pa., has severed his connection with that company, following the formation of the Burns & Roberts partnership. Mr. Roberts is also associating himself with the Burns Cement Gun Construction Company, the only change in his outlook being that he is now more intimately interested in the use of the cement gun than in its sale.

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Principal Contents

Toronto's Garbage Destructor Plant

GARBAGE disposal is one of a community's most important problems. The effective removal of the refuse and wastes collectively grouped as garbage is, in the last analysis, just as necessary as effective sewage disposal. Sanitation considerations should no more tolerate the fermentation and rotting of garbage refuse than it should approve of the pollution of water supplies by sewage wastes. The wonder of it is that ineffective modes of garbage removal and disposal have been so long rampant. Most cities are wide awake to the need of purification for their sewage; most have comprehensive sanitation and health legislation, and yet few seem to realize that the putrefaction of household wastes is a dangerous menace to public health.

The dump is the most extensively employed scheme for the disposal of garbage, but expediency appears to be its chief merit. The aesthetic instincts of a community, if nothing else, should react against a public dump. Its unsightliness, the odors of decomposition, and the fermentation of its contents, are all further arguments for more efficient disposal. The dump is warranted only when ashes form the greater share of the fill. The practice of gathering household wastes and ashes together is not to be commended. Ashes may make good fill; household wastes never.

* * *

For those municipalities that wish to undertake more effectual measures than a mere dump, complexities, of course, arise. The very fact that garbage contains organic matters with high oil and grease content opens the way to a process of reduction whereby these ingredients may be recovered and sold at a profit. Incineration or total destruction by burning, however, has the merit of simplicity, and is regarded by some authorities as possessing a minimum of objectionable features. It destroys combustible matters at such a high temperature that malodorous fumes are not apparent. The two processes are entirely distinct in methods as in results. Reduction aims at and, indeed, depends for its success largely on revenue. In addition, it may be argued that incineration at all times involves a bill of expense. Further, owing to the vast increase in the values of grease and tankage, garbage reduction may appear, at first thought, to be a process even more valuable for its revenue possibilities to-day than in normal times. As against this latter argument, however, it is pointed out by civic officials that within the last year or two the appeals for economy have so reduced the proportion of food wastes in the garbage content (the value of the by-products depends almost wholly on the presence of food wastes), as to greatly diminish the value of recoverable by-products. It is difficult, indeed, to forecast to just what extent the citizens' spirit of economy will govern garbage disposal in the future, but it is reasonably possible that the valuable by-products will be smaller in amount for some years to come. There is also the much greater capital expenditure to be consdered. De-tinning processes, now so vigorously applied in Great Britain, can scarcely find application on this continent, or at least in Toronto, owing to the high labor costs. As existing de-tinning processes can make use only of sound, unrusted, and unbattered tins, and as these must be carefully packed and freighted, the cost of labor for proper sorting and selection is prohibitive.

* * *

In an article published in this issue, Toronto's incineration equipment is described. The plant, while not the largest, is without doubt the most up-to-date on the American continent. Its construction and initial operation have been carefully watched by sister municipalities throughout Canada and the United States. It is now in complete operation, and is disposing of Toronto's garbage more effectively even than was anticipated. In nearly one-half of the city it has abolished the dump, and a second plant is now contemplated to cope with the remaining area.

It is known that Street Commissioner Wilson, under whose jurisdiction the operation of the plant falls, recommended originally a reduction plant which would have taken its place as a revenue producer. Such a plant would have been located in Toronto's new industrial section Ashbridge's Bay and would have been inoffensive in every respect. Recently developed processes can, in fact, guarantee results unaccompanied by odors or other disagreeable features. The city council, however, for various reasons, saw fit to refuse the commissioner's recommendation. The incinerator was then projected, and, while no revenue can be expected, it accomplishes in a most admirable way the primary purpose aimed at——the disposal of garbage. It accomplishes this, in fact, to a degree beyond the specified guarantee by an excess of 133 per cent. in capacity. In other words, the burning capacity is 233 per cent. of the guaranteed capacity. This result, developed under official test, is indicative of the superiority of the new installation.

The new equipment is the most modern that the science of incineration has developed. The location of the plant, in relation to the section of the city it serves, is admirably adapted to avoid the congestion of dump wagons either entering or leaving the building. The multiplicity of street approaches and exits prevents any noticeable concentration of garbage-hauling equipment. To the average observer, therefore, there is little to indicate the location or the nature of the building. It is further accentuated by the very noticeable lack of odor or smoke during actual operation.

An especially pleasing departure from the general trend of municipal practice is the housing of the equipment in a building of extremely attractive design. Too many public buildings of this character are so poorly planned as to be an eyesore. The city of Toronto has never been lax in its effort to provide pleasingly-designed buildings. Not only does the new incinerator building itself possess attraction, but its surroundings have been arranged in keeping. In short, an effort has been made to give incineration an air of respectability. It is not a process henceforth to be isolated or tabooed. Those familiar with the present site of the Don district of Toronto, with its mass of railways and industrial plants, will recognize the destructor as truly a star on the horizon.

Motor Trucks for Contractors

THE motor truck is a valuable acquisition to the progressive contractor and building material dealer. With the scarcity of good labor, so acute at the present time, motor transportation proves a boon by reducing labor requirements and showing a saving in time of haulage. A great many contractors and dealers are replacing their old equipment with mechanically-operated trucks.

A new profit of $30,000 a year is what six motor trucks earn for the owner of a building material and coal yard in the West; and this profit is earned after a depreciation charge of 33 1/3 per cent., interest at 6 per cent., and all operating and repair expenses have been charged. Revenue from the trucks is figured on the ton-mile basis at the rate which would have to be paid if the hauling were let to a contractor.

Back of these large earnings is the system that keeps the trucks actually hauling twenty hours a day. No time or labor is wasted in loading or unloading, and during the four hours in which the trucks are idle they are thoroughly inspected and put in such good repair that a breakdown during working hours is practically unknown.

Wear and tear is minimized by routing over the best roads. Often the shortest route is not chosen if the longer one will be easier on the truck.

The biggest single factor in earnings is the quick loading and unloading. All trucks are equipped with power dumps. At first the coal, stone, or sand was loaded into the trucks by hand. This took 20 to 25 minutes, and required the labor of four or five shovelers, at a cost of about 18 cents per cubic yard of material. On this basis the trucks earned only about 6 per cent. on the investment. To-day the trucks are loaded from an overhead steel hopper. This hopper is built of steel on a concrete foundation. It is loaded by means of a locomotive crane equipped with a 54-cubic foot clam-shell bucket, as well as by a stiff-leg derrick with the same bucket equipment.

Any loose material, such as sand, stone, and coal, may be successfully handled in this way. The material and the conditions of the business in this case make handling easy, but the principle back of it is fundamental—trucks earn dividends when they are hauling; time wasted in loading or through breakdowns is money lost.

Considerable time was lost, in an Eastern public service company, whenever a construction or repair gang found itself without some needed material or tool. The delay attendant upon calling the supply department and waiting for the truck to make a special trip with a single tool was expensive, as was sending out the truck with only a light load.

A special truck was designed to cut this expense. It carries, in special compartments, a day's supply of practically everything that an outside gang can need. The supply is replenished each night at the warehouse. Loaded in this way, it makes the rounds of the various jobs, and seldom has to go back to the supply department for material or tools. Since it was first put in service the wasted time has materially decreased.

A field where the difficulties of loading economically and cheaply are great is in transferring brick from cars or flatboats to trucks. When horse-drawn trucks were used for hauling, the time taken in loading 1,500 brick—the average wagon load—was not out of proportion to the time on the road delivering them. The coming of the automobile, with generally almost double the wagon capacity and half the traveling time, at once made this proportion a ridiculous one.

One contractor is escaping the difficulty by using the principle of the demountable body; several different applications of it are in use by his fleet of trucks, for he is still experimenting. The demountable body itself works well, for while the truck delivers one load another is being prepared. The chief objection is the expensive and elaborate apparatus that is necessary for lifting and suspending the bodies.

The trailer—practically a demountable body on its own wheels—accomplishes much the same thing without the use of any special machinery at all. Dump bodies, moreover, can be fitted without any difficulty to trailers and operated either by hand or by power from the truck ahead. Skiffs have also been satisfactory. These are individual compartments, cheap low platforms, with one high end. The loaders fill them while the truck is away. When it returns, it backs up, inclines the body as in dumping, and then quickly hauls the skiffs up the inclined floor by its own power winch. Four skiffs are used with some trucks, eight with others. The body is then returned to the horizontal position. When the load reaches its destination the body again inclines, and the skiffs are hauled out by the winch, with no damage to the brick.

General view of Toronto garbage incineration plant.

Toronto Incinerator Exceeds Guarantees

New Garbage Destructor in Official Test Develops a Burning Capacity 133 Per Cent. in Excess of Guaranteed Capacity—Equipped with Three Four-Cell High-Temperature Furnaces and Most Modern Appliances

By J. A Burnett*

THE Don incinerator plant of the city of Toronto has been recently completed, and is now being operated under the supervision of the Department of Street Cleaning. The original estimated time of completion was greatly exceeded, owing to numerous difficulties in securing experienced labor and materials, incident greatly to war conditions.

Description of Plant

The plant is located on the east side of the River Don and north of Wilton Avenue. It is connected to Wilton Avenue and Mount Stephen Street on the south and north ends respectively by means of substantial reinforced concrete bridges. The building is of fireproof construction throughout, it being built of brick, stone, steel, and reinforced concrete, at an approximate total cost of $200,000. The main building is 151 feet long by 81 feet 6 inches wide. Piles driven to refusal, 45 feet into the ground, form the subfoundation, upon which are constructed heavy concrete foundations, supporting the building, furnaces, and chimney. The building is designed with five different floors at various elevations, and are known as tipping, charging, stoking, main, and ash-run floors. The tipping floor is at an elevation approximately the same as that of Wilton Avenue, and is connected at the north and south ends to the streets referred to by the concrete bridges, over which the wagons enter and leave the building. The charging floor, which is 9 ft. below the tipping floor, is located on the west side of the building, the tipping floor being situated on the east side. The main or ground floor, the elevation of which is approximately the same as that of the Don roadway, is about 33 ft. below the tipping floor. On the extreme west side of the building the stoking floor is located, approximately 7 ft. above the main floor; from this floor the furnaces are fired and cleaned. Immediately below the stoking floor is situated the ash-floor, along which the residue from the furnaces is moved.

Ash Carried Away in Railway Cars or Wagons

On the northwest corner of the main building a wing is built, which is known as the ash building. This portion of the plant is equipped with a large steel ash bin, suspended from the ground floor, into which the residue from the furnaces is discharged; the bin is approximately 10 ft. above ground level, which permits the residue to be loaded into railway cars or team wagons, as desired. A railway siding is brought into the plant and passes under and through the ash building. The building portion of the plant was constructed under a general contract, it being designed and supervised in a very efficient manner by the City Architect's Department, while contracts for the piling, concrete foundations, chimney, furnaces, and appurtenances were awarded and supervised by the Department of Street Cleaning.

The plant is equipped with three high-temperature Sterling furnaces of modern design, which were installed and guaranteed by the Canadian Griscom-Russell Company, Ltd. The furnaces are of the top-fed,

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continuous-grate, regenerative type. They are each constructed with four cells, which are charged and cleaned individually. At the extreme end of the grates a spacious combustion and settling chamber is constructed. The by-pass flue, over which the regenerator

Garbage is dumped from tipping floor on right to charging floor and is charged into the furnaces through chutes.

chamber is built, completes the furnace construction. An elevated flue connects the furnaces with the main flue, which, in turn, is connected to the chimney.

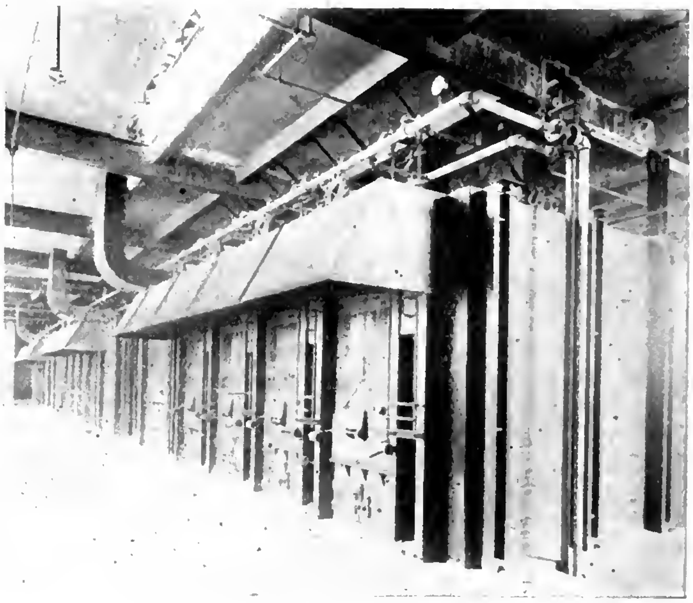
High Temperatures Remove Odor

Each furnace has a total grate area of 100 square feet, the cells each containing 25 square feet. The guaranteed burning capacity was 50 pounds of refuse per square foot of grate area per hour, when burning material containing not more than 940 pounds of water per ton of 2,000 pounds and not less than 460 pounds of combustible per ton. As stated above, the furnaces are designed and constructed for high temperatures, the specified temperature requirements being such that the combustion chamber temperature shall not fall below 1,250 degrees F. for more than three (3) minutes in any one hour, and that an average temperature of at least 1,400 degrees F. be maintained therein. From the above-stated requirements it may be readily seen that any objection due to the presence of obnoxious gases is entirely eliminated, as gases generated from the incineration of garbage are rendered odorless at a temperature of about 1,050 degrees F. Thus a leeway of at least 200 degrees F. is afforded. The temperatures are registered continuously on a chart by means of electrical recording pyrometers. An effective, superheated, forced draft system is embodied in the construction of each furnace, the draft being generated by means of direct-connected, motor-driven fans. The air, drawn from the top of the furnace front by the fan, is forced into the regenerator, which is similar in action to that of a vertical boiler. It consists of cast iron tube plates, top and bottom, which support a series of cast iron tubes inside the chamber. A portion of the hot gases from the combustion chamber passes through the tubes and discharges into the connecting flue. The air from the fan circulates around the outside of these tubes, it being baffled in many places. During this process the air is raised in temperature from that of the room to approximately 300 degrees F. The hot blast discharging from the regenerator passes through sheet metal piping, which connects with the air duct under the grates. Suitable valves are provided, and the admission of air under the grates is regulated conveniently from the stoking floor.

Charging Devices Operated By Hydraulic Rams

The charging devices for the cells are mounted on the top of each furnace, and consist of a steel container with bottom dump doors, into which the material is fed. The container doors and furnace charging doors are opened and closed mechanically, this being effected by the use of hydraulic rams, to which the doors are connected. The rams operate under city water pressure, and are controlled from the stoking floor level. Each furnace is equipped with individual dampers, which permit the shutting down of any furnace without influencing the operation of the others. Clean-out doors of ample size are spaced at frequent intervals throughout the different chambers and flues, which allow the various parts to be readily cleaned.

The furnaces and flues are constructed with common brickwork of sufficient thickness, the outside face walls being built of salt-glazed brick laid in cement mortar. The non-absorbing nature of these bricks permits the washing-down of the brickwork, and the glazed surface will not readily hold the fine dust, so that the furnaces can always be maintained in a clean and sanitary condition. The furnaces and flues throughout are lined with firebrick of first-class quality, at least 9 in. in thickness, with a minimum air space of ¾ in. between the firebrick lining and the brick walls. Heavy structural steel buckstays are spaced at suitable

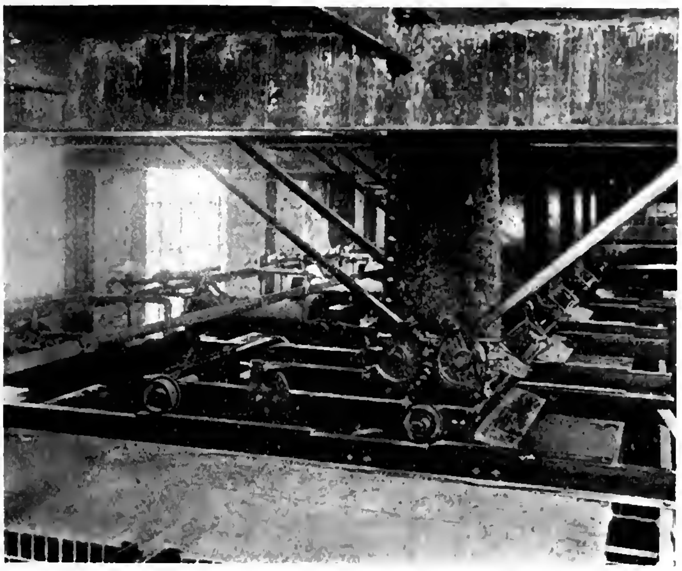


Front view of furnaces which contain three units of 4-cells each, showing ventilating hoods.

intervals, connected with large size tie-rods, for supporting the masonry of the various parts subjected to temperature strains.

175 Ft. Radial Brick Chimney

The radial brick chimney, which is located 25 ft. from the main building, was constructed, and is being guaranteed for a period of five years, by the Custodis-Canadian Chimney Company. It is built upon a massive reinforced concrete foundation, which is supported on a pile subfoundation, the piles being spaced 2 ft. 6 in. on centres each way and driven to refusal 45 ft. below grade. The base is octagonal in shape, and is built 25 ft. in height, with bricks of a color and laid in a manner the same as that of the main building. The radial portion is 150 ft. in height, constructed with radial perforated blocks throughout. The over-all height of chimney, from base to top, is 175 ft., with an outside diameter of approximately 15 ft. 3 in. at the



Low pressure hydraulic rams operated from stoking floor control garbage container and furnace charging doors.

bottom of the radial portion, which tapers to an outside diameter of about 10 ft. at the top. The chimney is lined from the foundation to top with a self-supporting firebrick lining, which is constructed with four pilasters and has an inside diameter of 90 in. The lining is built in four sections, varying in thickness from 13½ in. at bottom to 4½ in. at the top, an air space of at least 4½ in. being maintained throughout.

Plant Operation

The operation of the plant is very simple and effective. The material is delivered to the plant in the street cleaning department's new type of general-purpose single-horse wagons, and enters the building from the south end, after being weighed on a weigh scale located on the south driveway. The wagons are backed against the bumper beam on the tipping floor, and the contents dumped on the charging floor, after which the wagons leave by the north doorway and disperse along the several streets in close proximity to the plant. From the charging floor the material is fed into the containers by the charging men. The containers are operated by the stokers below. The material which is charged into the furnaces drops on a drying hearth at the back of the grates and is then drawn over on the grates, where incineration takes place. The flame and hot gases pass into the combustion chamber, where complete combustion is effected. The heavy dust falls into the bottom of this chamber and is removed through the clean-out doors. At the end of the combustion chamber a firebrick dividing arch is built, which splits the gases leaving the combustion chamber, of which a requisite portion passes on top into the regenerating chamber, while the remainder passes through the bypass flue below the regenerator. From these points the gases enter the uptakes to the connecting flues and thence through the main flue into the chimney.

Removal of Residue

The residue is drawn from the grates through large doors on the furnace fronts and is dropped into dump-cars located in the ash-run and operated on a narrow-gauge track. Trap-doors in the stoking floor are provided for this purpose, these being closed except when cleaning operations are in progress. The cars are moved to the north end of the ash-run and placed bodily upon an electrically-operated elevator, raised to the bin tipping floor level, when the car is moved over and the residue dumped into the large ash bin. This ash bin is equipped with a series of adjustable doors, thus allowing the further removal of residue from the plant in any desired manner.

Specifications for the furnaces and appurtenances contained many stated requirements as to capacity, temperatures, tests, etc., and same were based on a sample of garbage and refuse taken from one month of collection, the analysis of which was as follows:

Percentage of combustible	25.99
Percentage of moisture	47.66
Percentage of volatile	73.65
Percentage of ash	26.35
Calorific value in B.T.U.'s per pound:	
(a) Original sample	2,572
(b) Dry sample	4,914
(c) Combustible	9,897

Official Capacity Acceptance Test

During the months of April and May the contractors conducted the required test of thirty days' duration, operating under normal conditions, during which time the capacity of the plant was judged. On Tuesday, June 26, 1917, the official capacity and acceptance test was conducted, but was declared informal, due to the fact that during the test the electric power was off

Each furnace contains four cells with low divisions between each grate, making practically a continuous grate furnace.

for two periods, having a total of 45 minutes' duration, and also upon making evaporative tests it was found that the percentage of moisture was greatly in excess of the specification, due to abnormal, rainy conditions. Two days later, on June 28, another official test was conducted, under the supervision of the contractors and judged by the engineers of the Street Cleaning Department. Observations were made and readings taken at frequent intervals, the results of which are as follows, viz.:

Weather—Temperature: Maximum, 69 dgrees; minimum, 55 degrees; barometer, 29.71; humidity, 56.

Total refuse consumed	57.17 tons

Furnaces Tested, Nos. 2 and 3.

Duration of test	4 hrs. 55 min.
Number of charges burned in furnace No. 2	228
Number of charges burned in furnace No. 3	280
Total number of charges burned	508
Average weight per charge, pounds	225
Percentage of moisture	51.5
Weight of moisture per ton of refuse, pounds	1,030
Percentage of combustible	28.35
Weight of combustible per ton of refuse, pounds	567
Percentage of residue	20.15
Total weight of residue, pounds	2,353
Average time of clinkering	3 hrs. 16 min.

Furnace No. 2

Maximum temperature combustion chamber	2,325 degs. F.
Minimum temperature combustion chamber	1,350 degs. F.
Average temperature combustion chamber	1,920 degs. F.

Furnace No. 3

Maximum temperature combustion chamber	2,275 degs. F.
Minimum temperature combustion chamber	1,400 degs. F.

Draft is preheated in a regenerator shown here under construction. Part of the gases of combustion passes through upper passage and through vertical tubes and around which the air is circulated.

Average temperature combustion chamber	1,950 degs. F.

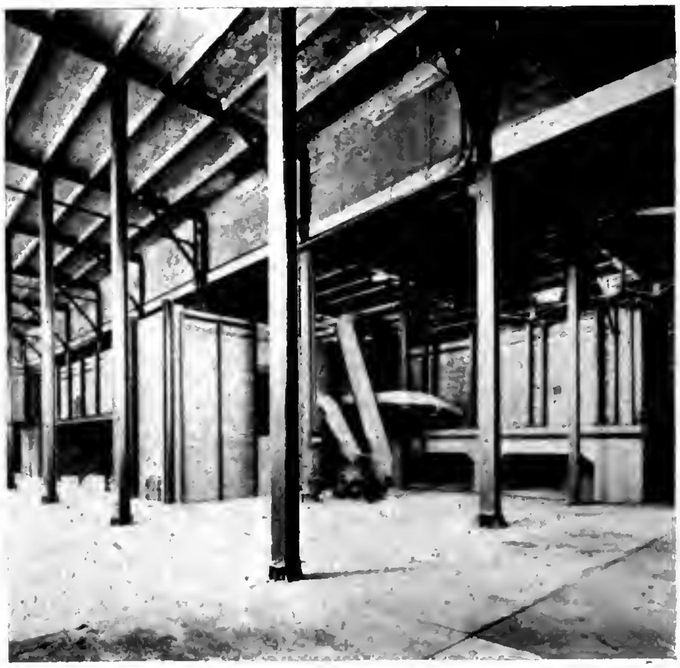
Note.—The minimum temperature on both furnaces was recorded at the time of starting test.

Furnace No. 2

Average air pressure under grates, inches	0.87
Average air pressure at regenerator, inches	1.9
Average temperature at regenerator	303.9 degs. F.
Average draft in bypass flue, inches	0.49

Furnace No. 3

Average air pressure under grates, inches	0.847
Average air pressure at regenerator, inches	2.6
Average temperature at regenerator	300.4 degs. F.
Average draft in bypass flue, inches	0.5
Maximum temperature chimney gases	1,100 degs. F.
Minimum temperature chimney gases	950 degs. F.



Showing back of furnace units with fan for forced draft. Draft is preheated by passing through a regenerator.

Average temperature chimney gases	1,020 degs. F.
Average draft at chimney base, inches	1.58
Total electric current consumed by fans, etc.	155 kw.
Electric current per ton of refuse	2.72 kw.
Refuse burned per hour per furnace, tons	5.83
Refuse burned per sq. ft. of grate area per hr., lb.	116.5
Man hours of labor for operating plant, including charging, stokers, clinkermen, dumping floor, weigh-master and foreman	1.59

Previous to making the test referred to above, the furnaces were operated for a period of about five hours, for the purpose of raising and maintaining the temperature throughout the furnaces and flues. Observations were made at the time of starting and completing the test, to ascertain the conditions of grates and containers, so as to ensure the same cycle of incineration. Requirements referring to density of smoke, analysis of residue and emission of dust from chimney, were found to be satisfactory during the test.

Actual Capacity 133 Per Cent. in Excess of Guarantee

By comparing the guaranteed burning capacity and the specified temperature requirements respectively with the results obtained during the test it is apparent that the difference is great, especially the high rate of burning, 116.5 pounds per square foot of grate area per hour, thus exceeding the guaranteed burning capacity of 50 pounds to the extent of 133 per cent.

The results of the tests being satisfactory, the contractors were relieved of the supervision of operation by the Department of Street Cleaning, the plant being thereupon accepted by the city.

Owing to the increased rate of incineration over the estimated amount, the mode of operation has been affected somewhat. The original intention was to operate the plant on a two-unit, day and night shift, basis, which was calculated to dispose of an average of 100 tons of material daily, but it has been found economical to operate the plant on a day-shift basis only with the three furnaces burning, especially as the efficiency of the plant has been equally maintained under normal conditions, operated under the supervision of the department. This system has many advantages over the day and night shift basis. First, the life of furnaces will be greater, as temperatures are maintained in a more regular manner and the number of times the furnaces are shut down is reduced to a minimum. Thus strains caused by expansion and contraction are eliminated to the least possible degree; also the most effective and economical method of disposal of garbage by incineration is to reduce the time of storage to a minimum, as otherwise it becomes packed and thereby more expensive to move. Under the present mode of operation an average of 100 tons of material daily is being disposed of during the day only. Two men are engaged during the night removing the residue from

Ashes fall through chutes in the stoking floor to narrow gauge dump cars which are lifted by elevator to ash hopper.

the grates into the ash bin, which permits burning immediately upon starting the next morning. A staff of one foreman, six stokers, and twenty laborers constitute the labor requirements for operating the plant. Experiments are now being conducted with a view to reducing the labor at present required, which is not as effective, due to war conditions, as would otherwise be the case.

Improvements to Site

In addition to the construction and operation of the plant, the surrounding property adjacent to the plant has been greatly improved. The bank at the south end of the plant has been terraced, graded, and sodded. An effective surface drainage system has been laid around the building for disposing of the vast amount of surface water that is shed from the banks surrounding the plant and yard area.

Street Commissioner Wilson experienced many difficulties during the inceptive stages of the plant, many objections being advanced to the location and operation of an incinerating plant. At that time he made statements to the effect that the incinerating plant, when completed, would in no way mar the district, but, on the other hand, would tend to enhance its value. It is indeed gratifying to note that his statement or promise has been kept in good faith, as those familiar with the site previously and at present will appreciate that a decided change has been made.

Engineering and aldermanic deputations from many large cities in Canada and the United States have visited the plant and, without exception, they have been unanimous in complimenting the department on the very complete manner in which the plant has been constructed and is being operated.

The Department of Street Cleaning, under whose jurisdiction the operation of the plant falls, is headed by George B. Wilson, commissioner. The writer is engineer of this department, and has been in charge of the work at the Don incinerator since its inception. The building was designed and its construction supervised by the City Architects' Department, of which W. W. Pearse is head.

Air Jet Cleans Pipe Piles on Philadelphia Subway

A THREE-INCH jet nozzled down to two inches is being used under 100-lb. pressure to clean out sand and gravel from the pipe piles being driven in Philadelphia to support the walls of the City Hall station of the new subway. The piles being filled with water, the jet acts as an air lift, blowing the sand and gravel out of the top of the pile with considerable velocity into the underpinning pit. While one pile is being cleaned it is necessary to cap the others driven in the same section, to prevent filling them. The piles, which average 18 or 19 feet penetration, are driven several feet at a time and then cleaned out with the jet to the bottom. Care is taken not to allow the air jet to get below the bottom of the pile, for fear of drawing in material from beneath the building. With one or two piles which stuck, however, it was possible to start them again by cleaning out 6 or 8 inches below their bottoms. After the piles reach rock, the jet is again put in and cleans out the pipe perfectly, removing everything except the hard rock. The jets are not worked into the material, but simply lowered until they touch the sand, when the pressure is turned on full force. The dirt that is blown out of the piles is cleaned out of the wall pits later by shoveling it into buckets.—Eng. News-Record.

C.S.C.E. More Closely Knit

BY resolution of the Council of the Canadian Society of Civil Engineers, and by recommendation of the executive committee, Mr. Fraser S. Keith, the secretary, is visiting the Western branches.

The main objects of Mr. Keith's visit is to foster a spirit of more cordial co-operation, to place before the members what the society is doing, to discuss matters which have come before the Committee on Society Affairs, and to generally establish a still closer bond between the branches and headquarters. Mr. Keith will meet the secretaries and executives of the various branches and will address meetings of the members. He knows the West, and his experience will no doubt be of value in the work of further building up what Mr. Duggan, the ex-president, described as a strong national society, representing the whole civil engineering profession in Canada.

Chloramine Purifies Water

Addition of Ammonia to Hypochlorite Results in a Greater Degree of Purification and Lessens Cost for Chemicals

AT Ottawa, Ont., the city bacteriologist, Mr. Joseph Race, has been conducting experiments on the chloramine purification of water. By this method ammonia is added to the hypochlorite dose in the proper amount, with a resulting increased germicidal action and a reduced B. Coli content. At the same time the cost for chemicals is very materially decreased. At the American Waterworks Association convention Mr. Race made public the results he has obtained by this method.

The experiments with ammonia led to a trial with this substance on a plant treating 200,000 imperial gallons per day; and, after the preliminary difficulties had been overcome, equally good results were obtained with the use of 0.25 p.p.m. of chlorine and 0.12 p.p.m. of ammonia as had previously been secured with 0.90 p.p.m. of chlorine in the form of bleach.

Excess of Ammonia to Be Prevented

These experiments showed that the important factor in securing results is to prevent the presence of a local excess of concentrated ammonia. When concentrated ammonia was added to the 0.5 per cent. solution of bleach inferior results were obtained. This was due to the formation of nitrogen gas and ammonium chloride, which have no germicidal action, together with a small amount of hydrazine. The best results were secured by diluting the ammonia in separate vessels until the solution contained 0.3 to 0.4 per cent. of anhydrous ammonia and discharging this solution through an orifice in the usual way into the hypochlorite discharge pipe just before its point of entry into the suction of the pump. The cost of materials on this experimental plant was reduced approximately 50 per cent. by the ammonia or chloramine process.

In 1917 this method was applied to the main plant, where 20,000,000 imperial gallons per day are treated without filtration or other preliminary purification. The results from this plant confirm those from the experimental plant. At one period during the spring floods the B. coli content of the raw water was reduced from over 500 to 2.5 per 100 c.c. by means of 0.6 p.p.m. of chlorine and 0.12 p.p.m. of ammonia, when the color was 40 p.p.m. and the turbidity 80 p.p.m.

Ammonia Produces Chloramine

The city of Hull, Que., treating the same water with liquid chlorine, reduced the B. coli index to 26.7 per 100 c.c. by the use of 0.7 p.p.m. of available chlorine. With waters such as the Ottawa River, which contain considerable amounts of organic matter, the chloramine process is more economical than either liquid chlorine or straight bleach, and the reduced chlorine dosage has eliminated any danger of odors and tastes that were occasionally observed.

The action of the ammonia is to produce a chlorine derivative of ammonia known as chloramine (NH_2Cl), which has been shown by Rideal to have a carbolic coefficient of 6.6 as against 2.2 for chlorine. Chloramine has no oxidizing effect, and the fact that the addition of ammonia to bleach destroys the oxidizing action and enhances the germicidal action has led to a reconsideration of the usual hypothesis that the germicidal action of chlorine and its compounds is due to the production of nascent oxygen. Figures are given which show that the germicidal action of chlorine is at least five times greater than its oxygen equivalent, and a hypothesis is suggested that the germicidal action of chlorine is a straight toxic one on the organisms. In most cases the greater part of the chlorine is used up in the oxidation of the organic matter, and it is by preventing this action that ammonia increases the germicidal action of hypochlorites.

Aftergrowth Problem Solved

More recently, at Denver Col., U.S.A., experiments on this process have been carried out. In this case, also, a saving in the cost for chemicals has been noted, with complete elimination of bacterial content in chlorinated filter water. Aftergrowth counts on gelatine in the Capitol Hill reservoir dropped within four days after the use of chloramine was initiated from 15,000 to 10 per c.c. The hypochlorite dose was also cut from 0.26 to 0.13 p.p.m. available chlorine. There was added 0.065 p.p.m. of anhydrous ammonia. These amounts were found to be the minima that could be used on the filtered effluent from a stored lake water.

At another point an unfiltered lake water had been treated with 2 pounds per million gallons of liquid chlorine. After application of chlorine, the gelatine count was 20 per c.c., but multiplication took place during the passage through a 48-in. conduit for ten miles, and the number would increase to 200. As this water enters directly into the city mains, no opportunity was afforded to note any further increase. The liquid-chlorine outfit has been abandoned at this point and the former hypochlorite plant put back into commission. Effectual sterilization without subsequent aftergrowths, either at the end of the conduit or in the city distribution system, is obtained by the use of 0.2 p.p.m. of available chlorine and 0.1 p.p.m. of anhydrous ammonia.

Until permanent plants are installed a 10 per cent. solution of ammonia will be used. Ultimately about a 1 per cent. solution of ammonia, equivalent to 0.29 per cent. anhydrous ammonia, will be provided for. A more accurate feed can then be obtained, and possibly the amounts may be still further reduced.

In using this mixture it has been found absolutely necessary to test each mix of bleach for available chlorine and then correct the amount of solution added to secure the required amount of available chlorine.

Tendency in Bridge Design

PRACTICE in the design of bridge structures, as indeed of most engineering works, has advanced by steady, progressive steps. There have not been any sudden new developments in the art, no outstanding ideas have relegated past practice suddenly to the background. Rather has there been a steady, upward trend in design developed as a natural result of better methods, better materials, and better knowledge. The bridge-building science of to-day has not suffered from any lack of improvement over past methods. The high plane which it occupies is a result of careful, graduated progress, and it is not to be expected that continued development will be any less progressive. The future will no doubt bring an already high efficiency art still nearer the ideal.

What distinguishes present-day practice from that of the past to a more outstanding degree than anything else is the extent of the live loads. Bridges to-day are being designed for heavier live loads than ever before. E-60 is the standard specification in widest use to-day by the railroads. Just a few years ago E-55 was considered the severest condition. Among many authorities this was regarded as the limit to which live loads would go. While some may conider E-60 as a maximum for any future service, in the light of past developments it is only reasonable to expect that this will be inadequate within a few years. There are, in fact, bridges being constructed with designed live loads as high as E-75, and these are not being built for emergency cases, but for regularly-applied loads existing at present. In view of this, it is hardly to be expected that design will stop at an E-60 loading. The probable loading in normal railroading may exceed this by many points. In fact, designers using the E-60 code may find their design as inadequate years hence as are E-30 bridges of some decades ago.

A railroad bridge built thirty years ago under the standards of that time and the bridge of to-day for the service of to-day, spans being equal, compare in weight and cost of superstructure about as one to three, states an authority. This gives some idea of what modern design involves when compared with that of a few years ago.

The present tendency is towards simplifying trusses. Lengthy panels with simpler arrangements of trusses and the elimination of subwebbing wherever possible, are characteristics of modern truss design. Panels are of 30, 32, and 34 ft., and longer, instead of the 15 to 18 ft. standard of a few years ago. Advance and progress in erection appliances have made this possible. Derrick cars or locomotive cranes can handle the heavier loads at longer reaches in at least the same proportion as shops can build economically longer and heavier members than formerly. Simplification is by no means limited to truss outline. The same tendency extends to all the detailing, bracing, and sections of members. In regard to the latter, economy is aimed at. All the material is made useful, and details and connections are made simple. The modern section is sturdier and less likely to get out of shape and suffer damage in shipping or handling.

Continuous bridge construction seems to be undergoing strong development. This is due largely to the replacement of riveted design for pin-connected design. Knowledge regarding the stresses existing in the continuous structures seems a little clearer, so that much of the former uncertainty has been removed. Present standard practice in truss details is entirely suited to continuous bridge work.

In recent years, owing to the increasing weight and size of structures to cope with larger loads, the matter of special steels has received considerable attention. Nickel steel has been used about fifteen years, and silicon steel has more recently been adopted by some designers. It is believed by many, however, that the newer high-strength materials will have very little influence on the design of ordinary structures.

The influence of concrete on steel bridge design may appear to be of moment, but for twenty years the two materials have stood side by side without entailing any great revision in steel bridge designing practice. In the matter of concrete floors only has any great influence been exerted. The trough type of solid floor, so frequently employed, has given way to reinforced concrete slab systems. On railroad bridges, however, the standard open-type construction is still used in nearly all instances.

Column Fire and Load Tests

Equipment for Subjecting Large Building Columns Under Load to Fire Action to Determine Effectiveness of Fireproofing

ABOUT two years ago the National Board of Fire Underwriters, the Associated Factory Mutual Life Insurance Companies, and the Bureau of Standards, acting jointly, prepared plans for a program of testing large building columns under load, at the same time subjecting them to the usual fire tests, with the view of determining the effectiveness of different types of fireproof columns now in use or proposed. The testing machine has now been installed in the Underwriters' Laboratories in Chicago, and the tests are under way.

The collection of columns on which tests have been begun includes samples of various types. Among these are rolled-steel sections, built-up steel sections, steel pipe filled with concrete, and vertically reinforced and hooped columns. It is proposed, also, to test several wooden columns. At least one of each of the sections is to be tested without protection; others are to be partly protected with concrete, and still others will be completely protected with various thicknesses of concrete, clay tile, gypsum blocks, and plaster on metal lath, in accordance with the methods commonly employed in building practice.

Test Equipment of Special Design

The test apparatus is described in Engineering News-Record. It is located in a fireproof building designed especially for work of this character. The central portion of the building is one storey high, with headroom of approximately 37 feet. At three sides of this portion the building is two storeys, with headroom of 17½ feet under the second floor. The central portion of the building is provided with sliding skylights that can be opened for ventilation and with a traveling crane.

Exclusive of two shallow pits at the bottom to receive falling material and carry off the water during the fire-stream tests, the test furnace has a height of 12 feet. In horizontal cross-section it is a 7-ft. square. Stationary brick walls form two of the opposite sides, while two movable brick walls in steel frames or panels suspended from overhead beams by trolleys provide the other two sides of the enclosure. The top of the furnace is of heavy fireclay blocks, supported by a steel frame. It is partly removable, to permit the installation of the columns to be tested. The bottom is formed by the fireproofing on the steel bearing plate and restraining frame of the loading apparatus. Four 13-in. flues, extending from the top of the furnace out through the roof of the building, carry away products of combustion. The fixed sides of the furnace have mica-glazed observation windows, so arranged that all parts of the column under test can be observed. Eight 6-in. blast burners of special design heat the furnace.

The apparatus employed in applying the loads to the columns during the fire and the fire-stream tests consists essentially of a hydro-pneumatic ram, the pumps and tanks supplying the pressure, the necessary restraining frames and the accessory pressure-indicating, controlling, and recording apparatus.

Hydro-Pneumatic Ram Applies Load

The ram has a rated capacity of approximately 256 tons; it is bolted to the under side of the heavy steel beams which form the top of the restraining frame, in such a manner that it will engage the top plate of the test column when that is in position. The column transfers the compression to the beams constituting the bottom of the frame, and these complete the action by transferring the stresses back to the top through steel tension cords, which form the sides of the frame. The ram is designed to maintain the load on the test column automatically and to develop characteristic deformation at the point of failure.

The temperatures within the furnace are indicated by means of thermocouples inserted through the walls near the top, middle, and bottom; temperatures at the surface of the structural portion of the test column are measured with thermocouples placed at several levels on the column.

Deformation and deflection of the column during test are taken by measuring the movements of protected wires attached one on each side of the column at both ends of a 37-in. gauge length. One end of each wire is attached to the column and the other is weighted and passed over an idler at a point outside of the furnace, as far away as room conditions permit. Movement is measured at intermediate points on the wires, and true movements at points of attachment of the column are calculated from the established ratio of distances.

Exposing Columns to Fire Action

For exposing heated test columns to the action of fire streams a special 4-in. hydrant is employed. There is hydrant location on each of the two sides of the furnace that have movable walls, the respective distances from the middle of the furnace being approximately 26 and 39 feet. A standard play pipe with a 1⅛-in. nozzle and with a pressure gauge tapped into its base will be used. The hydrants are connected with a 6-in. underground main supplied by a pressure tank and an electrically-driven fire pump of 500 gallons capacity. The hose connections on the hydrants are provided with pressure gauges and 2½-in. hose valves.

After being allowed to season for a period of about a year, the column to be tested is placed in the furnace and the top and bottom bearings are adjusted for even distribution of load. The connections for temperature and deformation measurements having been made, the furnace is closed and readings on all instruments taken. The safe load is then applied, and a second set of readings is made of deformation and deflection. The gas is then ignited, and gas and air are gradually turned on, to establish the predetermined temperature rise in the furnace. It is proposed to make this uniform for all tests, although the exact temperature figure has not as yet been announced by the board.

Recording Observations

Readings on gauges for load, on column and furnace thermocouples for temperature and on deformation and deflection instruments are taken in regular sequence at five-minute intervals up to a point near failure, the load being maintained as nearly constant as possible during the test. Observations of the visible effects of the fire on the column and its protection are made at regular intervals during the procedure.

After failure, the furnace doors are opened and the column is allowed to cool. Photographs and notes are made as a record of the general condition of the column. The covering is removed and its constituent materials investigated for deterioration due to fire.

When the fire-stream test is to be applied to a hot column, it is probable that the nozzle pressure of the hose stream will be kept at 50 pounds per square inch and the application maintained for five minutes, the tip of the nozzle being located 20 feet from the column. After suitable observation of the effects of the fire and the water, the furnace doors will be closed again, and the fire-and-water treatment repeated in the same or other predetermined manner.

Submerged Gas Main Laid in Winter Through Ice

In a paper before the Wisconsin Gas Association, Mr. A. F. Davey described the methods of installing a submerged gas main during winter weather.

The pipe, which was of steel 6 in. in diameter, weighing 19.36 pounds per foot, was assembled and lowered through the ice. The following notes descriptive of the work are of interest:

The pipe was to be connected up with river sleeves. This is a dresser sleeve, threaded on the inside, with gaskets at each end, and twelve ¾-in. bolts, six on each side, to draw the gaskets up tight. There is no expansion in these joints. Each of these sleeves weighs 140 pounds. The rubber gaskets, of triangular cross section, were duck-tipped.

Channel Sawed Out

Two expert sawyers, an ice plow, saws and ice picks, were obtained from the ice company. The course selected for the main was close to the bridge, and a channel was cut for taking soundings. The plow was used for marking out the trench on the ice. Two or three cuts were made with this plow, 15 in. apart. A horse was used for drawing the plow to a point near the channel where the ice was only 6 in. in thickness, where it was thought best not to use it. Two sawyers, one on each side of the trench, were used to cut the ice after it was marked out by the plow. A man with an ice pick followed them along, breaking the sawed ice into 3-ft. lengths and pushing them under the ice out of the way. Three men with a sounding bar followed the sawyers, taking soundings every 2 ft. The rod, or sounding bar, was marked off into feet and quarter feet, and was made from 1½-in. pipe. One man followed the sounders, keeping the records.

The river bed was found to have a natural slope from each side toward the channel, at which point it was 30 ft. deep. The work of sounding took about eight hours, being finished at 4 o'clock.

At 2 o'clock in the afternoon, after three-quarters of the work of sounding had been completed, the wind came up and blew across the river at the rate of 36 miles per hour. The temperature dropped from 8 degrees above to 6 degrees below. After the work of sounding had been done, steps had to be taken to protect the skaters and men from the coal docks who walk across the river, from the trench. A great many limbs cut from trees around the city by the electric department, that were piled near the gas works, were hauled to the job and placed in small holes made in the ice on the side of the trench about 5 ft. apart. These, with lanterns hung every 5 ft., were very effective. It was found out afterwards this was unnecessary, as at 6 o'clock the ice on the channel had frozen enough to walk upon.

Pipe Hauled on Skids

The pipe had been painted three coats of pipe paint applied hot, and had been piled up at the gas works. The pipe was hauled to the river bank on sleighs and placed upon an improvised sled made of 4 x 4's, and one horse was used to draw it out in place, ready for being screwed together.

The pipe, after being hauled out onto the ice, was placed directly over the trench, where the soundings were taken, and screwed together, six men being used for this work—one man on the tongs and the other five men pulling on the rope fastened to the tongs in order to draw the pipes up to the last thread. After two pipes were connected, one man followed them, putting in bolts and drawing them up. After the joints were tight, they were carefully gone over again with pipe paint.

All the pipe was screwed together on top of the ice and tested under 20 pounds of gas pressure. Two slight leaks in sleeves were found and repaired. The main was then tested again and found tight.

The drip was installed over the low spot in the river which had been found when sounding. The 6-in. service clamp was placed onto the main with a lead gasket. The service clamp had a 1½-in. opening, into which a 1½-in. street ell was inserted and the drip pipe extended about 100 feet east and 80 feet south to the nearest bridge pier.

Lowered With Block and Tackle

It was decided to start the work on Sunday morning and use yard men and drivers regularly employed at the gas works. Four double blocks and tackle were borrowed from the electric department and placed around the pipe and fastened to the bridge. A sawyer on each side of the pipe cut out the trench. Another man followed them along, pushing the ice out of the way. After 100 feet of trench had been opened, that much pipe was lowered into the river, the blocks being moved from time to time. At noon, after a bad start, about 150 feet of pipe had been lowered. After dinner work went along in good shape.

On Monday morning the work of lowering the remaining main and drip began. The drip was fastened to the main by strong wires and all lowered at the same time. Monday afternoon, at about 5 o'clock, the entire main was in place in the river. Early the next day a test was made. A sand hole in one of the fittings used on the drip was found, and therefore repairs were made without interfering with the main. A 30-pound test was put on the main at that time and found to hold for four hours, with only a very small loss in pressure. Nothing further was done with this main until in April, when the ice was all out of the river.

The cost of laying the river main was 15.5c per foot. The cost of patrolling and repairing the leaks by a diver brought this up to 27.5c per foot.

General Design of Concrete Structures

Report of Joint Committee, Continued from Last Issue, Covers Difficult Points in Beam and Column Design

8. Diagonal Tension and Shear

When a reinforced concrete beam is subjected to flexural action, diagonal tensile stresses are set up. A beam without web reinforcement will fail if these stresses exceed the tensile strength of the concrete. When web reinforcement, made up of stirrups or of diagonal bars secured to the longitudinal reinforcement, or of longitudinal reinforcing bars bent up at several points, is used, new conditions prevail; but even in this case at the beginning of loading the diagonal tension developed is taken principally by the concrete, the deformations which are developed in the concrete permitting but little stress to be taken by the web reinforcement. When the resistance of the concrete to the diagonal tension is overcome at any point in the depth of the beam, greater stress is at once set up in the web reinforcement.

For homogeneous beams the analytical treatment of diagonal tension is not very complex—the diagonal tensile stress is a function of the horizontal and vertical shearing stresses and of the horizontal tensile stress at the point considered, and as the intensity of these three stresses varies from the neutral axis to the remotest fibre, the intensity of the diagonal tension will be different at different points in the section, and will change with different proportionate dimensions of length to depth of beam. For the composite structure of reinforced concrete beams, an analysis of the web stresses, and particularly of the diagonal tensile stresses, is very complex; and when the variations due to a change from no horizontal tensile stress in the concrete at remotest fibre to the presence of horizontal tensile stress at some point below the neutral axis are considered, the problem becomes more complex and indefinite. Under these circumstances, in designing recourse is had to the use of the calculated vertical shearing stress as a means of comparing or measuring the diagonal tensile stresses developed, it being understood that the vertical shearing stress is not the numerical equivalent of the diagonal tensile stress, and that there is not even a constant ratio between them. It is here recommended that the maximum vertical shearing stress in a section be used as the means of comparison of the resistance to diagonal tensile stress developed in the concrete in beams not having web reinforcement.

Practice in Determining Web Reinforcement Stress

Even after the concrete has reached its limit of resistance to diagonal tension, if the beam has web reinforcement, conditions of beam action will continue to prevail, at least through the compression area, and the web reinforcement will be called on to resist only a part of the web stresses. From experiments with beams it is concluded that it is safe practice to use only two-thirds of the external vertical shear in making calculations of the stresses that come on stirrups, diagonal web pieces, and bent-up bars, and it is here recommended for calculations in designing that two-thirds of the external vertical shear be taken as producing stresses in web reinforcement.

It is well established that vertical members attached to or looped about horizontal members, inclined members secured to horizontal members in such a way as to insure against slip, and the bending of a part of the longitudinal reinforcement at an angle, will increase the strength of a beam against failure by diagonal tension, and that a well-designed and well-distributed web reinforcement may, under the best conditions, increase the total vertical shear carried to a value as much as three times that obtained when the bars are all horizontal and no web reinforcement is used.

Bond Between Concrete and Stirrups

When web reinforcement comes into action as the principal tension web resistance, the bond stresses between the longitudinal bars and the concrete are not disturbed as uniformly along the bars as they otherwise would be, but tend to be concentrated at and near stirrups and at and near the points where bars are bent up. When stirrups are not rigidly attached to the longitudinal bars, and the proportioning of bars and stirrup spacing is such that local slip of bars occur at stirrups, the effectiveness of the stirrups is impaired, though the presence of stirrups still gives an element of toughness against diagonal tension failure.

Sufficient bond resistance between the concrete and the stirrups or diagonals must be provided in the compression area of the beam.

The longitudinal spacing of vertical stirrups should not exceed one-half the depth of beam, and that of inclined members should not exceed three-fourths of the depth of beam.

Bending of longitudinal reinforcing bars at an angle across the web of the beam may be considered as adding to diagonal tension resistance for a horizontal distance from the point of bending equal to three-fourths of the depth of beam. Where the bending is made at two or more points, the distance between points of bending should not exceed three-fourths of the depth of the beam. In the case of a restrained beam the effect of bending up a bar at the bottom of the beam in resisting diagonal tension may not be taken as extending beyond a section at the point of inflection, and the effect of bending down a bar in the region of negative moment may be taken as extending from the point of bending down of bar nearest the support to a section not more than three-fourth of the depth of beam beyond the point of bending down of bar farthest from the support but not beyond the point of inflection. In case stirrups are used in the beam away from the region in which the bent bars are considered effective, a stirrup should be placed not farther than a distance equal to one-fourth the depth of beam from the limiting sections defined above. In case the web resistance required through the region of bent bars is greater than that furnished by the bent bars, sufficient additional web reinforcement in the form of stirrups or attached diagonals should be provided. The higher resistance to diagonal tension stresses given by unit frames having the stirrups and bent-up bars securely connected together both longitudinally and laterally is worthy of recognition. It is necessary that a limit be placed on the amount of shear which may be allowed in a beam; for when web reinforcement sufficiently efficient to give very high web resistance is used, at the higher stresses the concrete in the beam becomes checked and cracked in such a way as to endanger its durability as well as its strength.

Critical Section in Determining Shearing Stresses

The section to be taken as the critical section in the calculation of shearing stresses will generally be the one having the maximum vertical shear, though experiments show that the section at which diagonal tension failures occur is not just at a support, even though the shear at the latter point be much greater.

In the case of restrained beams, the first stirrup or the point of bending down of bar should be placed not farther than one-half of the depth of beam away from the face of the support.

It is important that adequate bond strength or anchorage be provided to develop fully the assumed strength of all web reinforcement.

Low bond stresses in the longitudinal bars are helpful in giving resistance against diagonal tension failures and anchorage of longitudinal bars at the ends of the beams or in the supports is advantageous.

It should be noted that it is on the tension side of a beam that diagonal tension develops in a critical way, and that proper connection should always be made between stirrups or other web reinforcement and the longitudinal tension reinforcement, whether the latter is on the lower side of the beam or on its upper side. Where negative moment exists, as is the case near the supports in a continuous beam, web reinforcement, to be effective, must be looped over or wrapped around or be connected with the longitudinal tension reinforcing bars at the top of the beam in the same way as is necessary at the bottom of the beam at sections where the bending moment is positive.

Inasmuch as the smaller the longitudinal deformations in the horizontal reinforcement are, the less the tendency for the formation of diagonal cracks, a beam will be strengthened against diagonal tension failure by so arranging and proportioning the horizontal reinforcement that the unit stresses at points of large shear shall be relatively low.

It does not seem feasible to make a complete analysis of the action of web reinforcement, and more or less empirical methods of calculation are therefore employed. The conditions apply to cases commonly met in design. It is assumed that adequate bond resistance or anchorage of all web reinforcement will be provided.

When a flat slab rests on a column, or a column bears on a footing, the vertical shearing stresses in the slab or footing immediately adjacent to the column are termed punching shearing stresses. The element of diagonal tension, being a function of the bending moment as well as of shear, may be small in such cases, or may be otherwise provided for. For this reason the permissible limit of stress for punching shear may be higher than the allowable limit when the shearing stress is used as a means of comparing diagonal tensile stress.

9. Columns

By columns are meant compression members, of which the ratio of unsupported length to least width exceeds about four, and which are provided with reinforcement of one of the forms hereafter decribed. It is recommended that the ratio of unsupported length of column to its least width be limited to 15.

The effective area of hooped columns or columns reinforced with structural shapes shall be taken as the area within the circle enclosing the spiral or the polygon enclosing the structural shapes.

Columns may be reinforced by longitudinal bars; by bands, hoops, or spirals, together with longitudinal bars; or by structural forms which are sufficiently rigid to have value in themselves as columns. The general effect of closely-spaced hooping is to greatly increase the toughness of the column and to add to its ultimate strength, but hooping has little effect on its behavior within the limit of elasticity. It thus renders the concrete a safer and more reliable material, and should permit the use of a somewhat higher working stress. The beneficial effects of toughening are adequately provided by a moderate amount of hooping, a larger amount serving mainly to increase the ultimate strength and the deformation possible before ultimate failure.

Composite Columns Designed With Caution

Composite columns of structural steel and concrete in which the steel forms a column by itself should be designed with caution. To classify this type as a concrete column reinforced with structural steel is hardly permissible, as the steel generally will take the greater part of the load. When this type of column is used, the concrete should not be relied upon to tie the steel units together nor to transmit stresses from one unit to another. The units should be adequately tied together by tie plates or lattice bars, which, together with other details, such as splices, etc., should be designed in conformity with standard practice for structural steel. The concrete may exert a beneficial effect in restraining the steel from lateral deflection and also in increasing the carrying capacity of the column. The proportion of load to be carried by the concrete will depend on the form of the column and the method of construction. Generally, for high percentages of steel, the concrete will develop relatively low unit-stresses, and caution should be used in placing dependence on the concrete.

The following recommendations are made for the relative working stresses in the concrete for the several types of columns:

(a) Columns with longitudinal reinforcement to the extent of not less than 1 per cent. and not more than 4 per cent, and with lateral ties of not less than ¼ in. in diameter 12 in. apart, nor more than 16 diameters of the longitudinal bar: 22.5 per cent. of the compressive strength, as given later, may be allowed.

(b) Columns reinforced with not less than 1 per cent. and not more than 4 per cent. of longitudinal bars and with circular hoops or spirals not less than 1 per cent. of the volume of the concrete and as hereinafter specfied: A unit stress 55 per cent. higher than given for (a), provided the ratio of unsupported length of column to diameter of the hooped core is not more than 10.

Conditions Governing Stresses

The foregoing recommendations are based on the following conditions:

It is recommended that the minimum size of columns to which the working stresses may be applied be 12 in. out to out.

In all cases longitudinal reinforcement is assumed to carry its proportion of stress as given previously. The hoops or bands are not to be counted on directly as adding to the strength of the column.

Longitudinal reinforcement bars should be maintained straight, and should have sufficient lateral support to be securely held in place until the concrete has set.

Where hooping is used, the total amount of such reinforcement shall be not less than 1 per cent. of the volume of the column enclosed. The clear spacing of such hooping shall be not greater than one-sixth the diameter of the enclosed column, and preferably not greater than one-tenth, and in no case more than 2½ in. Hooping is to be circular, and the ends of bands must be united in such a way as to develop their full strength. Adequate means must be provided to hold bands or hoops in place so as to form a column, the core of which shall be straight and well centred. The strength of hooped columns depends very much upon the ratio of length to diameter of hooped core, and the strength due to hooping decreases rapidly as this ratio increases beyond five. The working stresses recommended are for hooped columns with a length of not more than ten diameters of the hooped core.

Bending stresses due to eccentric loads, such as unequal spans of beams, and to lateral forces, must be provided for by increasing the section until the maximum stress does not exceed the values above specified. Where tension is possible in the longitudinal bars of the column, adequate connection between the ends of the bars must be provided to take this tension.

10. Reinforcing for Shrinkage and Temperature Stresses

When areas of concrete too large to expand and contract freely as a whole are exposed to atmospheric conditions, the changes of form due to shrinkage and to action of temperature are such that cracks may occur in the mass unless precautions are taken to distribute the stresses so as to prevent the cracks altogether or to render them very small. The distance apart of the cracks, and consequently their size, will be directly proportional to the diameter of the reinforcement and to the tensile strength of the concrete, and inversely proportional to the percentage of reinforcement and also to its bond resistance per unit of surface area. To be most effective, therefore, reinforcement (in amount generally not less than one-third of one per cent. of the gross area) of a form which will develop a high bond resistance should be placed near the exposed surface and be well distributed. Where openings occur the area of cross-section of the reinforcement should not be reduced. The allowable size and spacing of cracks depends on various considerations, such as the necessity for water-tightness, the importance of appearance of the surface, and the atmospheric changes.

The tendency of concrete to shrink makes it necessary, except where expansion is provided for, to thoroughly connect the component parts of the frame of articulated structures, such as floor and wall members in buildings, by the use of suitable reinforcing material. The amount of reinforcement for such connection should bear some relation to the size of the members connected, larger and heavier members requiring stronger connections. The reinforcing bars should be extended beyond the critical section far enough, or should be sufficiently anchored to develop their full tensile strength.

(To be continued)

Advantages of Handling Cement in Bulk

Portland Cement Association Conducting Campaign for More Efficient and Economical Deliveries — Handling and Measuring Methods

REFERENCE was made in the Contract Record of June 20, page 537, to the campaign urging the use of cement in bulk. The following information, supplied through the Portland Cement Association, throws additional light on the methods to be followed in handling the bulk material:

As a container for portland cement the wooden barrel is almost a thing of the past. The cloth sack and paper bag are similarly out of place on many construction jobs and in most plants where concrete products are manufactured.

The shipment of cement in bulk is neither new nor revolutionary. It is the simplest and the least expensive method of getting cement from the manufacturer's bin to the job. Bulk cement was first used about thirty years ago, but shipment in this form was not extensive until 1912. Then several contractors saw the possibilities of making a saving by handling their cement in the same manner as sand, pebbles, and crushed stone. Their success has led to a marked increase in the shipments of cement in bulk. There is every probability that in the near future the use of cement in sacks on large construction jobs, in cement products plants, and even on many small pieces of concrete work will be exceptional.

Not every job is adapted to the efficient use of bulk cement. Cement will always be retailed in sacks, but sacks should not be used when their use can be avoided. The cement user is the one who pays for this comparatively expensive means of handling cement. Cement must be reduced to bulk before use at the mixing plant—why put it into a package, only to empty it from the package on the job?

Nor is the consumer the only one who saves money by handling cement in bulk. More cement can be loaded with the same labor, which is an important item in times of labor shortage. There is a saving to cement companies, since loading is less expensive and sack inspection and repair are eliminated. This saving is turned over to the consumer by reducing the net price on his cement.

The big saving, however, is not in the original cost of the cement. Cement in bulk saves money because there is no sack loss, less labor from car to mixer, no labor to count, bundle, and return cloth sacks, no bookkeeping on sacks, no valuable space used for storage of sacks, no fire insurance to pay on sacks in storage, no hauling charges or freight to pay on sacks returned, no interest to pay on money tied up in sacks.

Sack Losses

Rejections of cement sacks returned to the mill by customers vary from 1 to 5 per cent. Education of workmen by contractors and dealers has resulted in largely reducing rejections, but care can only prolong the life of a cement sack and not prevent its final wearing out. The consumer pays for every worn-out sack, and an average cement sack makes abouе eight trips. This means that the 10 cents per sack which the consumer pays for sacks worn out, lost, etc., amounts on the average to 1¼ cents per sack, or 5 cents per barrel, on all cement shipped him. This may not be apparent at first glance, but if sack accounts are checked up it will be found that loss in sacks rejected, worn out, stolen, and otherwise unaccounted forf usually amounts to over 5 cents per barrel. The number of sacks not accounted for varies with the class of work.

Plants in which concrete products, such as block, fence posts, pipe, piles, roofing tile, etc., are manufactured have a better opportunity to control the sack problem, since the work is done under roof and with the constant supervision of the foreman or manager. But under any circumstances, unless vigilance is used, the workmen will put the cement sack to various uses, the cost for which will run into a considerable total in a year's time.

Labor in Handling Cement

Cement in cloth sacks must be carried, sack by sack, from the car, storage shed, or warehouse to the mixing platform, where each sack is untied and emptied into the mixing hopper. Each sack must then be shaken and thrown in a pile far enough from the mixer to avoid getting wet. From time to time during the day, or at the end of the day's work, the sacks are taken to the warehouse, where they must be counted, sorted, piled, and tied in bundles and space provided for their temporary storage. The bundles must then be hauled to the freight station, requiring labor and teaming charge. Freight is paid on the empty sacks to return them to the cement mill.

An empty sack weighs seven ounces. One hundred new sacks weigh about 44 pounds, but a bundle of 100 old sacks weigh about 80 pounds. The additional 36 pounds represents cement left in the sacks which the customer does not use and pays freight on to return to the cement company. Freight on returned sacks will average about 10 cents per 100 pounds.

Interest on Investment

The customer is required to pay for cloth sacks or paper bags. Credit on cloth sacks returned is not given until they are received, which is usually 30 to 90 days after the cement is shipped. The cost per barrel which must be allowed for the money tied up in cloth sacks represents a useless investment, while the money paid out for paper bags is an absolute loss. By some the interest on money tied up in sacks is found to be as high as 1 cent per barrel, and this investment in sacks idle for a period of 30 to 90 days prevents the use of the money for some other purpose.

Class of Work on Which Bulk Cement Has Been Used

Bulk cement was first adopted on contracts where cement was used in large quantities at a location near a railroad siding. On these jobs cement was transported by wheelbarrow direct from the freight car to the mixer. Successful use on several such contracts interested railroad engineers and railroad contractors, who very shortly began using cement in this form on track elevation and other miscellaneous construction work. Large building contractors were next to fall into line, but in nearly all instances cement was used direct from car to mixer, and for that reason the idea became prevalent that bulk cement was suitable only on centrally located jobs where cement was used in large quantities. Such, however, is not the case.

Methods Employed

On most railroad work no special facilities are necessary, and cement is wheeled direct from car to mixer. This method will also be found suitable for large construction jobs, such as dams, factories, power plants, etc., when car supply is regular, but in times of irregular car supply and high demurrage charges a bin should be constructed for the storage of cement on the job. This bin should be so located that there is the least possible labor required for unloading cement into the bin and conveying it from the bin to the mixer.

Concrete products plants will find economy in constructing a bin with or without conveying machinery, depending on size and layout of the plant. On street and road work, or where the job is not on a railroad siding, cement may be hauled in tight bottom or dump wagons from car or warehouse to the work, where it may be unloaded into storage boxes or used direct from the wagons.

The question may arise as to what is to prevent the cement in bulk from being damaged by rain, but it must be remembered that sacks do not keep cement dry, and when a sack of cement gets wet there is not only a loss of cement, but the sack also becomes useless. Moisture penetrates rapidly through sacked cement by capillary action in the cotton, whereas with bulk cement the loss is limited to the cement actually getting wet. With bulk cement in a given case of leaky roof, there will be one lump of set cement weighing 50 pounds; with cement in cloth sacks in the same case there will be 50 pounds of set cement; but it will be in 20 sacks, the sacks as well as the cement being damaged.

Unloading Bulk Cement

Unless the railroad siding is well above the floor level of the storage bin, some form of bucket elevator or conveyor is desirable to elevate the cement into the bin quickly and with minimum expense. Such equipment may be obtained from one of a number of manufacturers, several of whom have designed special machinery for this purpose. The cement may be shoveled by hand to the elevator boot or a power shovel used to unload the car in the same manner as a grain car is unloaded. Seven to ten horse-power is required for unloading 200 barrels in three hours by means of a simple bucket elevator and power shovel. If greater speed is desired a larger shovel and faster elevator, requiring correspondingly more power, may be installed.

Handling and Measuring Bulk Cement

The size and character of the job will determine what method should be used for measuring and handling the cement.

For large construction work using concrete from a central mixing plant the cement is drawn from the storage bin into automatic weighing or measuring hoppers, from which it is delivered to the mixer. In some instances belt or screw conveyors are used.

For jobs which will not justify the expense of such equipment, measurement in wheelbarrows or bottomless boxes set in wheelbarrows will be found satisfactory.

In a concrete products plant it is possible to work out methods for handling all of the materials mechanically. For handling bulk cement, the drag conveyor, belt conveyor, screw conveyor, or bucket elevator are commonly used. Wherever labor can be eliminated by use of conveyors, additional savings should be credited to the account of bulk cement. If the volume of cement handled is small, it is probably unwise to install expensive equipment. Some cement products plants are using bulk cement, handling it in measuring boxes or wheelbarrows in the same way as sand and stone. If the volume of business is large enough to justify the use of conveyors for the aggregates, the same manner of handling cement will usually be found desirable.

Arrangements for handling bulk cement on roads and pavements are usually about the same as for handling cement in sacks. It may be transported to the work direct from cars to warehouse in wagons, automobile trucks or trailers, where it may be used direct from the conveyance or dumped or shoveled into storage boxes. Both methods are in use by prominent road contractors.

Recently Completed Montreal School

THE Robin Street Girls' School, constructed for the Roman Catholic school commissioners of Montreal, consists of a basement and three storeys, on a site 140 x 70 feet. It has been designed by Bigonesse & Bigonesse, architects, Montreal. The building is of concrete and St. Lawrence pressed brick, with Montreal limestone trimmings and a granite base. The floor slabs and supporting beams and columns are designed on the Trus-Con plan, controlled by the Trussed Concrete Steel Company of Canada, Ltd., who also supplied the reinforcing steel. The walls have a backing of terra cotta, and are finished in plaster.

In addition to the class-rooms, living accommodation is provided for the teaching nuns, with a laundry, cellar for provisions, and toilet in the basement, which also contains a large recreation room and space for the heating and ventilating apparatus.

The feature of the ground floor is a recreation hall 31 x 80 feet, which is situated in the centre. Four class-rooms, each 25 x 30 feet, with cloak-rooms, are located in the front of the building. On either side are offices, waiting-room, library, and a drinking-room with nine fountains.

The second floor consists of seven class-rooms, a drinking-room, and toilets, the class-rooms being separated into two sets by means of a central corridor, which leads to a stairway at either end.

The top floor is set aside for the nuns, and consists of fourteen bedrooms, parlor, community-room, kitchen, refectory, chapel, room for cooking instruction, and infirmary.

The floors are constructed of concrete and steel floretyle, which is supplied by the Trussed Concrete Steel Company of Canada, Ltd., and finished in hardwood. The partitions between the class and other rooms are of terra cotta and plaster. The lavatories have marble partitions and tile floors. The stairways leading from the entrances, one at each end of the building, are of concrete, with iron and slate treads.

A switch button elevator is installed. Iron fire-escapes are placed at the back of the school. These are accessible from concrete balconies built out from each floor, having doorways opening out on them at either end.

The playground is on the roof, which is covered with tile. In order to protect the children a balustrade of brick runs right round the building to a height of four feet above the roof level.

Hydrated Lime for Waterproofing Concrete

By Bela Nagy *

CONCRETE is impermeable or watertight when it does not permit the passage or flow of water between the grains or in the individual grains through its pores or voids. If the pores or voids are sufficiently large and connected from surface to surface of the wall, the concrete will be permeable to water.

It is only natural that any material or method whose purpose is to make concrete watertight must have for its aim the elimination of visible voids or structural defects and the reduction of the less visible passages by diminishing their size and filling them with finely distributed material of a colloidal nature.

Before discussing waterproofing by the addition of some material other than portland cement and aggregates let us dispose of the one way whereby concrete may be made watertight without the addition of any waterproofing agent.

Rich Mixtures Waterproof

Against limited pressures concrete may be made practically watertight without the use of any other material than portland cement and the aggregates. This is possible only with sufficiently rich mixtures of the proper consistency, selected aggregates carefully graded, and with supervision and workmanship.

Of course, the addition of any material will not compensate for ignorance or carelessness, but should assist in producing reliable results with ordinary care and less labor.

Such material should possess the following characteristics:

1. It should be easily mixed with water and the other ingredients of concrete.
2. It should in no way injure the concrete, either chemically or physically.
3. It should enter the mixture in its most effective form, and not rely for its waterproofing effect on chemical reaction with any of the ingredients of concrete. It should be permanent, and not subject to decomposition or decay, and therefore it should be a mineral compound, rather than organic.
4. The material should be finely divided, bulky, and preferably of a colloidal nature, so as to lubricate the mass during handling and placing and act as a void-filler in the hardened concrete.
5. It should be inexpensive, so as not to increase the cost of concrete materially.
6. It should be obtainable wherever cement is used or sold.
7. It should be easy to proportion, handle, and incorporate in the mix.

Hydrated Lime Secures Watertightness

It is not our purpose to discuss integral waterproofing compounds in general, but rather to show how nearly hydrated lime fulfills these requirements and accomplishes its work of making concrete watertight.

Hydrated lime is a dry, flocculent powder, produced by the slaking of quicklime under standardized factory conditions and expert supervision.

It makes concrete watertight by a three-fold action. First by reducing the possibility of visible, physical defects; second, by reducing the size of the interstices or voids; third, by acting as a void-filler.

Hydrated lime is a very plastic material of construction, and has been used for years in mortar, plaster, and stucco. It easily unites with water. After being wetted it loses its granulas character and is converted into a smooth, colloidal paste that imparts great mobility to concrete to which it is added.

On account of its lubricating properties toward external objects it will slide through the chutes at a smaller angle for a longer distance than concrete without it; it will fill the forms more perfectly with less spading, and surround the reinforcing steel more closely. And all this occurs without the use of an excess of water and at such a consistency that the paste is firm enough to keep both the fine and coarse aggregates in suspension and uniformly distributed throughout the mass, resulting in a more homogeneous, dense, and strong concrete with better exterior surfaces.

Permits Proper Amount of Water

If we consider the fact that concrete, as proven by Bureau of Standards and other tests, containing an excess of water may be several hundred per cent. weaker than one with the right amount, any agent that permits concrete to be handled at the right consistency, without an excess of water, is a factor of safety added in the field.

Considering hydrated lime purely as a waterproofing, it produces watertight concrete by eliminating larger structural voids through right consistency of the mass; it reduces the smaller voids and pores through precluding the use of an excess of water and through internal lubrication which permits the particles to easily slide over and past each other, thereby ranging in the most advantageous position and finally by filling even the small pores with a finely divided, colloidal mass.

Retains Moisture

There is a further action which takes place in the interior of the hardened concrete which is of the greatest importance. The hydrated lime holds water mechanically bound and materially retards its evaporation. After the Portland cement has used up the water in indirect contact with it for its early hydration, it draws on the water held by the hydrated lime, and this serves for further hydration of the cement and the development of the colloid, which factors are of extreme importance both for the increase of strength and watertightness. This must be apparent to all who know how important it is to keep the hardened concrete well supplied with moisture during its early age.

It is well known that if concrete is permitted to dry out shortly after its hardening, or, in other words, before it has acquired sufficient tensile strength, it will contract and check or crack. And, of course, the effectiveness of waterproofing is destroyed when a break of continuity occurs in the concrete. In later age, also, hydrated lime has the effect of preventing rapid moisture changes in the concrete which is important in reducing expansion and contraction caused by alternate wetting and drying.

The handling of this material is easy, as it is marketed mostly in paper bags of 40 to 50 pounds net weight, although it is obtainable in 100-pound cloth bags. The proportioning and addition to the other materials does not require any complicated preparation.

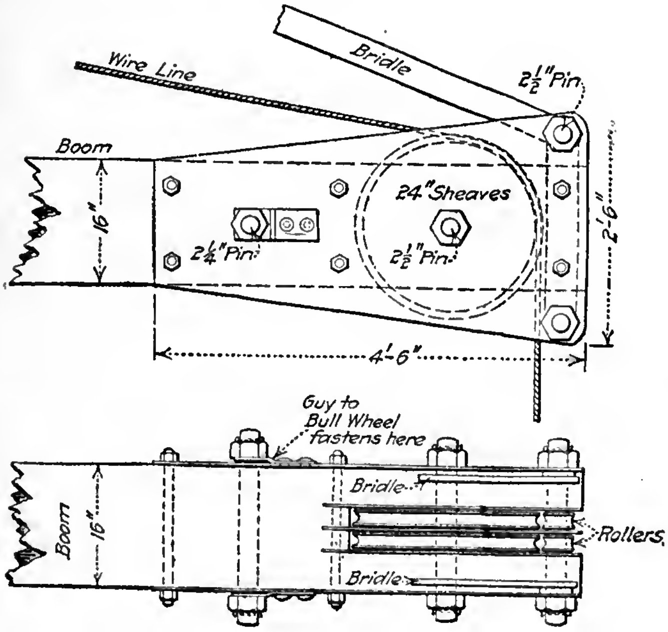
* Chief Engineer, Hydrated Lime Bureau.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Boom End That Prevents Lines from Wearing or Jumping Sheaves

THE sketch shows a rigid boom end being used on the derrick boats. The inside plates shown aid in keeping the lines in the sheaves, and these boom points have proved very rigid and give excellent service. Five plates are used, two on either side of the stick, one between the boom and each



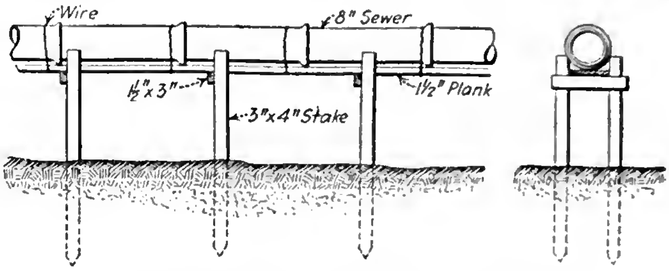
Rigid boom that prevents jumping of lines.

sheave and one between the two sheaves. The sheaves, 24 in. in diameter, are set side by side and held by a $2\frac{1}{2}$-in. pin passing through them and through all five plates. The bridle, holding the boom line, is attached by a $2\frac{1}{2}$-in. pin to the upper outside corner. Small steel rollers, running on the bolt through the lower outside corner, prevent the lines from wearing.

Sewer Pipe Laid Before Fill to Save Future Excavation

TO save future excavation, sewer pipe, as shown in the accompanying sketch, has been laid before fill was made at Ohio River dam 39. A trench dug for the sewer pipe after the fill had been made would have had to be sheeted, as the material was fine sand and gravel. Hence it was decided to lay the sewers first, if possible, and fill around them.

Crosspieces, at the proper grade, nailed firmly to stakes driven into the original ground, supported a $1\frac{1}{2}$-in. plank, upon which the pipe was laid. The supports were spaced about 3 ft. centre to centre, thus preventing the plank from sagging with the weight of the pipe. The pipe was wired to the plank, to further



Sewer pipe carried on plank supports until fill is made.

hold it in position. When fill was placed, it was carefully tamped under and around the pipe and plank.

This method will allow the fill time to settle before taking the weight of the pipe, which, of course, it may do eventually if the plank rots.—Engineering News-Record.

Block and Tackle Arrangement Enables Motor Truck to Load Itself with Pipe

BY an ingenious arrangement of block and tackle, a motor truck was made to load itself with pipe from gondola cars. The arrangement is described in Engineering and Contracting. For unloading the cars a 35-ft. gin pole was erected and guyed to the ground. As the work of hauling was done with an electric light line crew, the erection of gin poles and guying was simply a matter of every-day routine, and required but little over an hour. A set of double blocks with 1-in. manila rope to which was attached a ½-in. steel guy sling fitted with hooks was used for lifting the pipe out of the car. When ready to load, the end of the line was snapped onto a hook at the back end of the truck, the piece weighing 2,100 pounds was hoisted to clear the car and the end of the manilla line snubbed.

The truck then backed under the pipe and the pipe was lowered away. This operation was repeated three times with each load, and the total time required, from the time the truck arrived at the car until it left with the load tied on, was between six and seven minutes.

In hoisting out of the car it was generally necessary to attach a small line with double blocks from the pipe to the side of the car. This was eased off gently as the pipe started to leave the bottom of the car, in order to prevent injuring pipe or car. In loading, the crew was disposed as follows: One man handling truck, one man on car hooking slings into each end of the pipe and handling the small block which prevented pipe from thrashing around as it was lifted, one man to receive pipe and get it onto the bed of the truck, one man to snub rope when pipe was lifted and lower away at the proper time.

For unloading the truck two skids 4 x 6, about 9 ft. long, shod one end with iron so as to hook into the bed of the truck, were used. A sling of 1-in. rope was thrown over each joint of the pipe and snubbed at the opposite side of the truck and the pipe was readily eased down into place.

In all 9,000 feet of 20-in. cast iron bell and spigot pipe was unloaded and distributed. This was accomplished by means of a two-ton truck and crew of four men. As high as 100 tons of pipe per day were handled, working two shifts of men, and the truck running for about fifteen hours. This included spotting the car, taking pipe out of the car, tying the load on the truck, hauling to the job, a distance a little under a mile, and distributing along the job. Several round trips were made in 18 minutes where the haul was less than half a mile each way. All loads included three length of 12-ft. pipe.

Pavement that Carries Heavy Traffic of 28 Vehicles per Minute

A CENSUS of vehicular traffic in New York City has been completed by the Fifth Avenue Association. The point at which the census was taken is Fifth Avenue and Forty-second Street, the heaviest traffic centre in the United States. The avenue is 55 ft. wide at this point, and theoretically accommodates six lines of vehicles.

A count was made of vehicles of all kinds passing the public librar , between Forty-first and Forty-second Streets, fr m 8 a.m. to 6 p.m., 16,960 vehicles having passed during the period of ten hours, or an average of 28 vehicles per minute. The traffic was about evenly divided between northbound and southbound vehicles, there being 8,513 of the former and 8,447 of the latter. The total volume of traffic included 1,296 motor buses, numbering about 130 per hour in both directions. Passenger motor vehicles composed about two-thirds of the traffic, and these included the motor buses which are heavier than most commercial cars.

The pavement carrying this enormous weight as well as volume of traffic, as pointed out by the association, is of interest. The type of construction is sheet asphalt, 1½ in. close binder and 1½ in. top, on a 6-in. concrete base. It was laid in 1913, replacing a similar pavement which was seventeen years old when relaid. The analysis of the top mixture used in this pavement shows a high percentage of bitumen and a correspondingly high proportion of fine material. An average of 11.7 per cent. of Trinidad asphalt was maintained throughout the laying of the pavement, although 10.5 per cent. was all that was required. The complete analysis of the surface mixture is as follows, the standard being given for comparison with the actual composition of the Fifth Avenue pavement:

	Standard.	Fifth Avenue.
Asphalt	10.5 p.c.	11.7 p.c.
200 mesh	13	17.3
100 "	13	10
80 "	13	22
50 "	24	23
40 "	11	5
30 "	8	8
20 "	5	2
10 "	3	1

The box meaurements for the top mixture were 720 pounds of sand, 105 pounds of dust, and 175 pounds of asphalt cement. For the binder course the measurements were 600 pounds of stone, 310 pounds of sand, and 90 pounds of asphalt cement.

Shipbuilding Superintendent

Some responsible parties desire to get in touch with a capable superintendent to take charge of the building of small steamships for a company which is going into this work in France. There would be a splendid opening for a man with boat-building experience, speaking both languages. Further information by addressing "Ship-Builder," care of "Contract Record," Toronto.

The contract for the supply of 5,000,000 plastic brick for the new Parliament Building, Ottawa, has been awarded to the National Brick Company, of Laprairie, Ltd., Montreal.

Position of the Engineer in National Affairs

By H. W. Buck*

There has been much discussion concerning the position of the engineer in modern times, but conditions are changing so rapidly and points of view are undergoing such a fundamental evolution that it is well from time to time to review the relations of the engineer to his surroundings and to secure if possible the proper orientation.

The Accomplishments of the Engineer

The change and improvement in the engineer's position in the world in recent years have been so rapid as to surprise even those who were the optimists in the underdog days of the engineering profession. In the middle of the last century, when the engineering and technical schools began to be formed in this country by men of far-seeing vision, the classical scholars looked on askance and took pains to differentiate these upstart institutions from their own traditional schools of learning and to ostracize those who pursued the new courses by classifying the professions as "learned" and technical.

*President of the American Institute of Electrical Engineers. Read before the Institute.

Times fortunately have changed. The engineering profession is coming into its own. To-day the engineer is being swept along by a tide which he himself has created with an irresistible force, and it is well therefore for the engineer to take his eyes off his work occasionally and to observe his constantly changing surroundings. A flood of scientific and technical accomplishments has swept over the face of the earth, revolutionizing life, commerce, and international destinies. Even the turmoil in which the world now finds itself can probably in the last analysis be traced to the over-acceleration of world affairs resulting from the work of the scientist and engineer.

In all this development period of the engineering profession during the last century the engineer has worked his way along alone and in silence, so to speak, seeking his reward rather in the joy of accomplishment and in the realization of his dreams than in worldly recognition and accumulation. The very inherent greatness of the pioneers who have laid the foundations upon which we now build prevented them in a way from acquiring a more worldly position in affairs. This tradition, however, is not a virtue beyond a certain point, and the engineer by nature is too willing to give way to others. The time has come when he should take a more worldly position in the world which he himself has created.

Emerging from Classical Period

In our general relations to intellectual development we may consider that we are just emerging from a classical period where tradition, custom, prejudice, ignorance, and dogmatic religion were the controlling forces. Movements which took place in world affairs were largely political, following the paths best suited to the advantage of the ruling classes. There was little real progress, because there was no development of scientific knowledge and its application in engineering. Scientific truth held no standing. The worship of tradition caused a powerful reaction against any scientific discovery which might necessitate a readjustment of established habits of thought and life.

For centuries before the dawn of the scientific and engineering era great changes took place throughout the world, but little real progress occurred. Races rose and fell, always falling back to the starting point, for there can be no upward trend in racial development without the solid basis of scientific knowledge to grow upon. China made great progress and developed its early civilization under scientific activity, but during recent centuries it has lived under the worship of classical tradition and has become inert.

A constant change in point of view, which is so largely brought about through developments in scientific knowledge, seems to be necessary for progress in civilization. Our civilization today differs from that of a century ago in proportion to the scientific and engineering evolution which has taken place during the period through its reactions on life in all of its phases. Such discoveries in science as the law of gravitation, the evolution of species, the laws of electromagnetic induction, etc., have probably had a more profound effect upon the development of the human race than any other acts in history.

The Engineer in Human Affairs

The engineering profession has passed through the preliminary stages of its growth and has reached a position where the engineer should work and act not only with proper attention to his work itself, but with full consciousness of the important relation of his work to human affairs in general. Among the early pioneers in engineering were many notable instances of men of great breadth of view. Specialization had not at that time begun to work its narrowing influences. Of recent years, however, under the stress of commercial development and economic conditions, increasing specialization has taken place and the engineer has become obliged to compass his mind with an ever-narrowing horizon. This specialization produces extraordinary proficiency in particular fields, but has the objectionable effect of narrowing the character and outlook of the man and of reducing his value as a citizen. We must take care lest commercial considerations and the modern mania for efficiency in the narrow sense force our engineers to lose sight of the world around them in their concentrated attention to the part rather than to the whole. This excessive specialization is a danger which threatens the future standing of the engineer.

It is interesting to recall in this connection the results of a recent canvass made by a joint committee on education on the qualities which, in the opinion of about 5,000 leading men, engineers and others, best fit a man for a successful career as an engineer. As a result of this vote only thirteen points out of a hundred were assigned to purely technical knowledge as an essential, the other eighty-seven points being allotted to broader qualifications, such as judgment, character, human understanding, etc. This is merely a quantitative statement of the many general demands now being made of the engineer, and it illustrates how his work has broadened out. It is an interesting and encouraging symptom.

A most significant movement of recent times in the engineering world has been the development of co-operative action among engineers of all classes, and this tendency will, I believe, serve to offset the evils of specialization. It is the growing recognition of the fact that all branches of engineering are interdependent. We electrical engineers, I believe, are well aware how much we need the assistance of other branches of engineering for the successful fulfillment of our purpose.

The Engineering Council

This co-operative movement has quite recently been given tangible expression in the formation of the Engineering Council, an act, I believe, of far-reaching consequence. Under this organization as a beginning the Civil, Mechanical, Mining and Electrical societies, together with the United Engineering Society, are tied together for co-operative action through a joint body of twenty-four representatives. This body will meet at frequent intervals and will deliberate on matters of general interest to engineers. It is an encouraging beginning toward universal co-operation among engineers in all branches of work.

In this Engineering Council we have for the first time an engineering body representing about 30,000 engineers of sufficient scope and standing to create an engineering public opinion. Its influence is likely to be far-reaching in building up the prestige of engineers in both technical and civil affairs. A further development which has reached full recognition only in recent times is the mutual appreciation which has grown up between the engineer on the one hand and the worker in pure science on the other.

The engineer looks to the scientist to provide him with raw materials of knowledge with which to work out his application, and the scientist must look to the engineer to make his discoveries so fruitful that the full effectiveness of his work on the frontier of research can be sustained. Both are working together in order to unfold nature in the most effective way for the benefit of man.

We electrical engineers, I think, feel a particularly close bond with the pure scientist in that recent developments in physical science have disclosed an intimate relationship between electrical phenomena and the nature of energy and matter.

All of the important movements taking place at the present time which center around the engineer and his work mean, I believe, that the engineer is soon going to leave his position of isolation in independent fields of work and realize that he owes an obligation to the community broader than his daily engineering work and will contribute to the general welfare his talents and experience. It matters not whether the problems before him are political, sociological, industrial or technical, I believe that the engineering type of mind, if the proper breadth of view has been acquired, is best fitted to undertake them.

Resourcefulness and Imagination of the Engineer

It is not necessary, perhaps, in important administrative positions to have civil, electrical or mechanical engineers as such, but we do need men in those positions who have had training of the type which engineering gives, with the mental balance, the power of analysis which such a training develops, the resourcefulness and the faculty or recognizing and properly apportioning the various elements in a problem. There is a quality of mental honesty which engineering experience highly develops which is sorely needed in public life. The scientific and engineering professions should rise up and furnish such men from their ranks for the welfare of the country.

The classicist contends that a world dominated by scientists and engineers would be cold, materialistic and atheistic, and lacking in those qualities of art and sentiment and the imaginative outlook which every civilization so highly prizes. To this doctrine and its injustice to the engineer I want to take emphatic exception. The world today may be inclined toward materialism, but it is not dominated by the engineer—far from it—but by other classes.

The engineering mind, on the other hand, numbers among its characteristics a highly developed creative imagination and possesses to a high degree exactly those qualities of mind and temperament best suited to combat materialism. There have been many instances in history of great artists who have been great engineers and vice versa, and I believe that the two temperaments lie in close relationship. Furthermore, scientists and engineers as a class have a strongly developed spirit of international understanding and sympathy which may serve as an important safeguard against excessive nationalism and excessive aggression as well.

And so, gentlemen, I believe that we can confidently look forward to a new era for the proper fulfillment of the destinies of the engineer. Out of this world chaos we now see men of engineering and scientific training rising to positions of commanding prominence on all sides. It is simply the working of the inevitable law of the survival of the fittest.

In this great movement not only must the individual engineer play his part, but the great engineering societies must realize the power of influence which they are developing in an ever-increasing degree in the community at large and the obligations which devolve upon them.

Mainly Constructional

East and West—From Coast to Coast

Mr. Alexander Gillespie, for twelve years resident engineer at the Waterworks Department, Brantford, Ont., has tendered his resignation, to take effect on September 1.

Four new steel bridges, with spans varying from 100 to 140 feet, are to be built to complete the Toronto-Hamilton highway, crossing the creeks at Mimico, Etobicoke, Port Credit, and Bronte.

The Globe Engineering Company, Ltd., has been incorporated, with a capital of $100,000, and will take over as a going concern the assets and liabilities of the Globe Electric Machine Company, Ltd. The head office of the company is at Hamilton, Ont.

The good roads schedule recently adopted by the Council of Kent County, Ont., has received the approval of the Lieutenant-Governor-in-Council. The by-law covering this project was passed at the June sesson of the council, and involves the most extensive improvements ever undertaken in connection with the county roads.

Building permits issued in Vancouver, B.C., for the month of July number 46, and are valued at $27,602, as compared with 29 in the same month last year, at a value of $156,465. The total of the permits for the first seven months of 1917 is 307, at a value of $331,496. This compares with 260 permits in the corresponding period last year, valued at $590,515.

The Merton Street bridge, in the city of Toronto, is now nearing completion, and work will probably be finished in the course of a few weeks. The structure has three spans, the centre one being 40 ft. wide and those on either side 25 ft. It will be 24 ft. high at the highest point, and the width will be 26 ft. from curb to curb, with two 7-ft. sidewalks, making a total of 60 ft.

The Toronto Board of Control has given the Harbor Commission authority to raise $2,000,000, in addition to the amount they have on hand, for reclamation work which is to be carried on without interruption during the next two years, at a cost of $2,750,000. In addition to reclamation work in the Ashbridge's Bay area, the commission will continue the harbor improvements east of Bathurst Street.

It is stated that the water supply at Rockland, Ont., is endangering the health of the inhabitants, and Senator W. Cameron Edwards, who operates the pumping plant, has been served with notice by the Provincial Board of Health that he must within 30 days establish an adequate system of sand filtration. If this order is not complied with the board will institute proceedings against the senator.

An agreement has been made between the Imperial Munitions Board and the York Township Council by which the latter undertakes to supply water to the aviation camp at Armour Heights, in the township. Eight thousand feet of 24-inch main has been laid down to the camp, and the munitions board agrees to turn over this main to the township free of cost at the close of the war, if the township cares to exercise the option.

A new continuation school, built as an extension to the old public school on Fifth Street, in New Toronto, is now near completion. This addition is costing $26,000, and will provide accommodation for 200 pupils. It is in the rear, and contains four large rooms, including a semi-circular kindergarten room, constructed almost entirely of windows and directly at the back. On the third floor an auditorium has been provided, 35 by 38 feet, which has a seating capacity of over 300, and will be fully equipped for stage and motion picture purposes.

Personals

Mr. W. P. Hinton, formerly traffic manager of the Grand Trunk Pacific Railway, has been appointed vice-president and general manager of that road, succeeding Mr. Morley Donaldson ,who has retired on account of ill-health.

Lieut. Laurence B. Kingston, of the Canadian Field Artillery, has been awarded the Military Cross. He is a graduate of applied science in McGill University, and was practising as a civil engineer in Toronto before his enlistment in 1915.

Lieut.-Col. Charles H. Mitchell, M. Can. Soc. C.E., D.S.O., C.M.G., of the firm of C. H. & P. H. Mitchell, consulting engineers, Toronto, who was recently decorated by King George for his services at the front, has also been made an officer of the Order of Leopold by the King of Belgium.

Lieut. D. M. Ewart, of the Canadian Engineers, a graduate in applied science of McGill University, has been awarded the Military Cross. Before he volunteered Lieut. Ewart was resident engineer at West Toronto for the C.P.R.

Obituary

Mr. George Bromley Kirkpatrick, who until a year ago held the position of director of surveys under the Ontario Government, died recently at his home in Toronto. Mr. Kirkpatrick was born in Ireland in 1835 and came to Canada in 1857. Having taken up surveying, he entered the Department of Crown Lands at Ottawa in 1866. Following Confederation he moved to Toronto with the government, in 1867, and was appointed director of surveys in 1878. Mr. Kirkpatrick was among the oldest and best-known civil servants in Ontario, and was first president of the Association of Ontario Land Surveyors.

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Principal Contents

Highways or Railways—Which?

THE province of Ontario is preparing for the inauguration of a vast hydro-electric railway scheme. The cheap power with which Ontario is blessed is to be made available by a system of interurban railways which will in time interlace the province from end to end. In addition, Ontario is already witnessing the construction of good roads in accordance with an extensive highway proposition. New legislation makes it possible for the Highway Department to select provincial highways to connect the great centres of the province and on these roads to expend their best energies towards securing the highest type of construction comparable with the traffic that will be borne. When completed this provincial system of highways, linking up with the excellent county and township systems already under way, will be a further factor in Ontario's economic development.

Each of these schemes has staunch supporters and ardent advocates, but there are those whose minds seem to incline a little more to one side than the other. By some, it is believed that the road scheme will interfere with the success of the radial proposition, and vice versa. Hydro-electric partizans are strenuously opposing any extensive programme of the Highway Department, while road building advocates fear the inroads of the electric railways. What is Ontario's proper course? Is it right to develop the interurban railway scheme under the incentive of cheap power, or would it be a wiser line to concentrate energy on the upbuilding of an ideal highway system? Or do conditions justify both?

* * *

The main consideration in analyzing the needs in this regard is the development of traffic efficiency. Transportation is the big item. Adequate facilities for the marketing of agricultural and manufacturing products are features that have the most weight. True, human travel is no small consideration, but this must always, we believe, be largely taken care of by the speedier, more concentrated and more certain train service.

The cardinal requirements of the transportation problem are adequacy, flexibility and economy of freight haulage. Transportation of commodities rapidly and promptly from all productive areas to all points is essential. The construction of interurban electric railways aims to secure this end. So does the building of interurban roads. In Ontario, with cheap power, haulage by railway will be inexpensive. This is a big argument. The railways, however, lack the flexibility necessary to cope with even ordinary traffic, much less with the difficulties being experienced under the present conditions. Railroads follow fixed lines of communication. This factor puts a limitation on the time of transportation and also the haulage capacity. Flexibility in railroad service is thus to some extent limited. The congestion existing to-day gives evidence of the inadequacy of the railroads to cope with transportation needs. This is, no doubt, abnormal, but it has already, by necessity, compelled producers to use the highways wherever those in good condition are available.

* * *

Systematic and intelligent road-building will solve the problem. Lateral lines of highways are obviously indispensible to give any degree of flexibility to railway service and through lines are just as necessary. The various road building programmes being taken up in Ontario by the counties, as well as by the Department, will provide a method of handling freight most expeditiously. Under urgent conditions, these highways will be a means of bearing concentrated auto-truck traffic and thereby opening markets to marketable products. Ontario must not, for her own good, neglect her road-building programme. It is essential to the interests of the province, its manufacturers, its farmers, its producers and its consumers.

This must not be construed as an argument against the construction of an interurban railway system. We believe that the building of such will be a very important factor in the economic situation of the province. The facilities of both electric lines and highways can go hand in hand. While long hauls are a factor, the railroad must be considered pre-eminent unless all roads are uniformly improved with low grades and high-class surfaces. Electric railways, with cheap power and sufficient connections and branch lines, will be the acme of railroad flexibility, so far as such is possible and in themselves will be feeders to the highway systems. Ontario, with splendid roads and splendid electric railways, will have the haulage problem solved in an almost ideal manner. One must not give way to the other; the province is big enough to have both.

The Engineer in National Affairs

IT is a matter of constant comment and regret in engineering circles that engineers, in general, appear to take so small a part in national affairs. We say "appear" deliberately, for it is quite possible that the influence of the engineering mind on the trend of modern times is much greater than it seems on the surface. It must be remembered that an "engineer" has been a man apart and that engineering education in any form has been looked upon as something entirely inadequate and of a lower rank than, for example, the classics. At the same time, therefore, that he has been shaping, in no small measure, the progress of world events, he has been "living down" the prejudice with which he was surrounded, and almost smothered, at his birth.

That he is actually and gradually overhauling this unfair and unreasonable handicap is shown by the gradual change that is coming over the lay mind with regard to the value of an engineer's equipment and experience. He is now, occasionally at least, given the opportunity of demonstrating his value and the problems he is called upon to solve are more diverse. No one who understands the training of the engineer fears for the outcome. His mind is naturally constructive, his methods are synthetic, "building" is his chief aim in life. What better type could we develop to handle, in due course, the affairs of the nation?

Establishing Returned Soldiers

THE Military Hospitals Commission is asking the press to use its efforts in clarifying the situation regarding the status of returned soldiers. The commission has just issued a small card entitled, "What Every Disabled Soldier Should Know." This is being distributed to invalided soldiers at the convalescent hospitals and at the sanitaria and other institutions where military patients are being cared for. Canadian Red Cross representatives are undertaking the distribution in the United Kingdom. The card aims to make clear the agencies that are organized to look after the needs of the soldiers, and to help them to become fit for civil life and aid them in getting new positions. A leaflet entitled, "The Soldier's Return," has also been prepared, even more for the civilians' information than for the soldiers'. These circulars lay emphasis on the fact that the soldier can do much to help himself by making himself determined to get in proper condition. Every day brings evidence that the spread of such information is still greatly needed, both by soldiers and civilians. Many do not realize what has to be done or what is being done to secure the disabled soldier's restoration to ability and his firm establishment in a career of self-supporting industry. Yet this is absolutely essential if he is not to suffer when the labor market is no longer in its present quite abnormal state. There must be a clear understanding and hearty co-operation on the part of the public.

Engineering Council Down to Work

THE Engineering Council, a body recently organized in the United States to represent the various national engineering societies, has already considered many matters of interest to engineers in general. Standing committees have already been appointed to deal with public affairs, rules and finance. The council has also created a war inventions committee to co-operate with departments at Washington, if desired, in the promulgation to engineers of war problems now before the government, and for which there are opportunities for solution by means of invention. A committee has also been organized to collect and compile such information regarding the engineers of the country as will enable the committee to co-operate with the different departments of the federal government on request, and to assist in supplying the government's need for engineering services. Judging by the aims of this new organization, it seems apparent that it is following along the track of the Joint Committee of Technical Organizations, which is aiming to co-ordinate the engineering profession throughout Canada in much the same way as the Engineering Council.

Tests on Wood Paving Blocks

TESTS have recently been made to determine the comparative bleeding qualities of creosoted wood paving blocks of the plain, rectangular and lug types. They were tested by being subjected to compression in Riehle hydraulic testing machine of 42,000 pounds capacity. The loads were applied in increments of 25 lbs. per square inch of block at intervals of one minute. All blocks were tested on the side. Observations were made of the total deformation of the block at each load increment and also the amount of bleeding caused by the pressure. The oil and water squeezed out was absorbed by blotters and these were weighed before and after the test to determine the amount of oil lost by the blocks at the various pressures. The areas of the bleeding were determined from the imprint left on the blotters. The tests showed the superiority of lug blocks over the rectangular with regard to bleeding. For the same expansion, the rectangular blocks would exert a lateral pressure considerably in excess of that exerted by the lug blocks, and for the same amount of expansion the rectangular blocks bled 3½ times as much as the lug blocks.

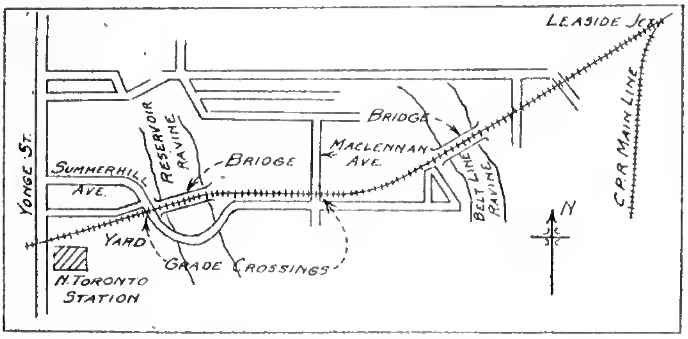
Research Council in Calgary

Dr. McCallum, Dr. Ruttan, and Dr. Adams, of the Honorary Advisory Council of Research, were in Calgary on July 17 and 18. A committee from the Calgary branch of the Canadian Society of Civil Engineers met them and escorted them over the city, pointing out to them manufacturing plants and other establishments which would be of interest to them in their investigations. The committee, together with members of other technical organizations, afterwards met with them in conference to discuss the carrying out of the work of distributing questionnaires, and other matters pertaining to the work of the council in Southern Alberta. The members of the Advisory Council addressed a representative gathering at a luncheon given by the Calgary Board of Trade.

Concrete Trestle Bridges with Pre-Cast Decks on C.P.R. North Toronto Improvement

Existing Bridges to be Removed Before Constructing Double and Triple Track Concrete Structures — Double Tracking and Reduced Grades

During the last few years the Canadian Pacific Railway has been making very extensive improvements to its North Toronto subdivision. This line, running east and west across the northern part of Toronto from Leaside, a few miles northeast of the city, to West Toronto, northwest of the city, was many decades ago the main line of the C.P.R. into Toronto. However, in recent years this line has, until latterly, been used to carry secondary traffic only, chiefly freight or through trains which



Location of C.P.R. North Toronto line. The existing steel bridges are to be replaced with concrete structures.

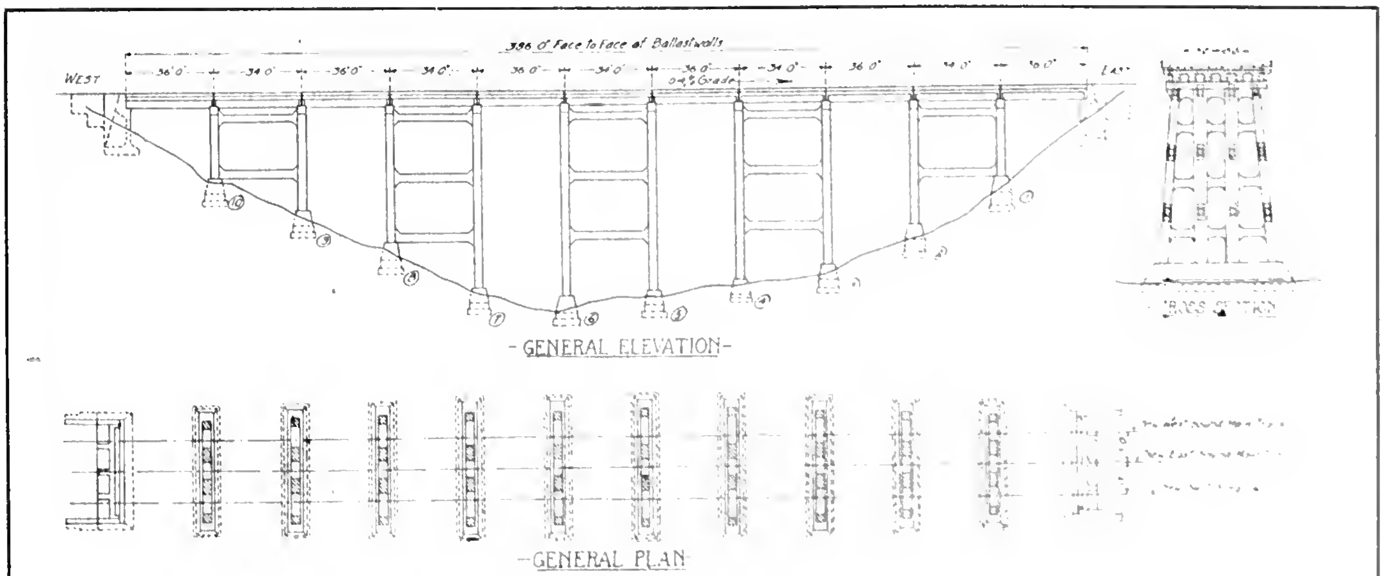
desired to avoid the circuitous and heavily-graded main lines leading into the present Union Station at the extreme south of the city. The Leaside-West Toronto subdivision is, however, several miles shorter and on a better grade than the present main lines, besides which it is a connecting link between the two C.P.R. trunk lines on the east and west respectively. Further, owing to the gradual concentration of population up-town within recent years, this line is adapted to serve the needs of the greater part of the city really more favorably than the railways as at present located.

For these reasons it was decided some years ago to improve the facilities of this line, and make it capable of handling a greater share of the traffic, at the same time helping in a measure to relieve the already overtaxed terminal facilities at the Union Station.

With the co-operation of the Canadian Northern Railway, the C.P.R. therefore built a new North Toronto station on Yonge Street, and the line westward to West Toronto was double-tracked and elevated to remove the great number of level crossings. This work was completed in 1916. Articles in the Contract Record of December 29, 1915, and July 12, 1916, described fully the details of this work. At the present time similar improvements are being inaugurated on the remaining two miles of the line from the new station eastward to Leaside. This line, on which work is already started, will be double-tracked, to connect with the double-track main line to Montreal at Leaside. Upon completion of this improvement the C.P.R. will have double-track service into Toronto from both east and west.

Present Line Is Single Track

The existing line is single track from the North Toronto Station to Leaside. About one-half of it is within the city limits, and intersects two streets with grade crossings. At miles 0.9 and 1.8, measured from Leaside, there are two large single-track steel bridges. These were built many years ago, and are of steel trestle construction, with deck-plate girder spans, founded on stone masonry pedestals resting on clay. The bridge at mile 1.8—the nearer to the North Toronto Station—crosses what is known as the Reservoir Ravine. The other bridge crosses the Belt Line Ravine, through which is located the disused steam beltline branch of the Grand Trunk. From the Reservoir Ravine to near the Belt Line Ravine, about a distance



The new bridges are to be of reinforced concrete trestle design with pre-cast deck. This drawing illustrates the three-track structure.

of one mile, there is an existing 0.6 per cent. grade. From there east to Leaside the grade is practically level. From the North Toronto Station to the Reservoir Ravine bridge there is at present an 0.5 per cent. down grade. This was imposed by the elevation of the tracks west of the station. A freight yard between the Reservoir Ravine bridge and the North Toronto Station, located on a level lower than the main line, completes this subdivision of the C.P.R.

Concrete Trestle Bridges to Be Built

The city and the railway company have been negotiating for some time in regard to the elimination of the level crossings already referred to. These are known as Summerhill Avenue and Maclennan Avenue. As the matter stands at present, these crossings are to be maintained under the new improvement, but it is believed that they will be both eliminated in the near future and a new road located east of the Reservoir Ravine and crossing the railway right-of-way by a subway. A proposal to have a double-deck bridge did not meet with favorable opinions on the part of some parties.

Progress of work at Reservoir Ravine bridge. The wooden trestle work will carry trains temporarily. The excavations are for new footings. The steel bridges will be removed before constructing the new bridge.

The C.P.R. engineers decided a short while ago to build steel structures alongside the existing bridges to carry the additional tracks. This plan has been abandoned, however, in favor of reinforced concrete bridges. To make room for these the present steel ones will be removed. One of the illustrations reproduced herewith shows diagramatically the general arrangement and type of structure to be erected across the two ravines. The design is rather unusual. As will be seen, the new bridges are of the reinforced concrete trestle type, founded on continuous piers resting on clay subsoil. Each bent contains four posts, tied together, with the end posts battered. The trestle spans are 34 ft. and the mid spans 36 ft. The abutments are of ordinary design. An unusual feature of these bridges will be the deck, which is composed of longitudinal T-beams. These will be pre-cast and set in place after the completion of the trestle work. They will be then grouted, waterproofed, and the tracks laid in ballast. Two sidewalks, with railings, will be provided.

The bridge over the Reservoir Ravine will be a three-track structure, the south track acting as a switching lead to the freight yard. It will be 386 ft. long and 94 ft. high at the highest point. The bridge over the Belt Line Ravine will be identical in design and size, with the exception of accommodating but two tracks. The concrete yardage in the three-track structure will be around 7,000 cubic yards. The reinforcing will amount to 500 tons.

Steel Bridges Will Be Removed

The existing steel bridges will be demolished before the erection of the new structures. To carry traffic in the meantime, temporary timber trestles are being built north of the present track alignment. The demolition of the bridges, which is being done by contract, will be performed in such a manner as to make the material available for future use. If freight cars can be obtained, the steel will be transported to the C.P.R. shops at Angus. If any scarcity of rolling stock is felt, the members will be temporarily stored along the right-of-way.

Wells & Gray, Ltd., Toronto, have the contract for the erection of the new three-track concrete bridge over the Reservoir Ravine. The Canadian Pacific construction department is building the temporary wooden trestle at this point. At the Belt Line Ravine the Dominion Construction Company are building both the new bridge and the temporary trestle.

Grade to Be Revised

Besides double-tracking the line, the grade is being revised so as to give a maximum of 0.4 per cent. The down-grade from the North Toronto Station to Summerhill Avenue is being reduced to 0.3 per cent. From there to the Belt Line Ravine the grade is 0.4 per cent., with a level grade thereafter. These revisions will make the new bridge at the Reservoir Ravine three to four feet higher than the present structure, while the one at the Belt Line Ravine will be unchanged in height. The curvature is not materially altered, except for the transposition of the double-track line from one side of the right-of-way to the other at two places.

The work which has already been done in connection with the improvements has been limited chiefly to the partial erection of the temporary trestles and to excavations for footings. The temporary trestles are framed up of the accepted style of timber bents, built on mud sills, with I-beam stringers. The photograph reproduced herewith gives some idea of the general type of construction that is being followed. At the east ravine the timbers are being erected by means of a derrick car. No special equipment is being used for erection at the west ravine.

Excavations for the concrete piers are already under way at the Reservoir Ravine. These are shallow cuttings within wood sheeting. No difficulties are being experienced, the subsoil being stiff clay. At this bridge two concrete plants have been constructed, one on each side of the ravine. Each one will supply concrete for one-half the structure. The plants comprise towers and chutes. For pouring the footings the chutes are laid on the hillside. On the right-of-way at the east of the ravine a yard has been located for the manufacture of reinforced concrete T-beams. These will be cast in forms which are now being manufactured and will be ready for placing when the trestles are completed. In the meantime very little further can be performed on the new bridges until the completion of the temporary bridge and the removal of the old steel.

Construction Camp at One Site

At the Belt Line Ravine the Dominion Construction Company have prepared a yard for the manufacture of the deck beams, this being located near Leaside. The organization at this site differs from that at the other in having a construction camp, the greater part of the labor being kept on the job. This camp comprises several bunk-houses and living quarters for a considerable number of men. A large clam-shell has been erected for unloading purposes, and will handle all stone and sand for the single mixing plant to be located on the west side of the ravine.

The bridges were designed by the Canadian Pacific department of bridges, of which P. B. Motley is engineer. The work is being supervised by Mr. Barber, divisional engineer of the C. P. R. in Toronto.

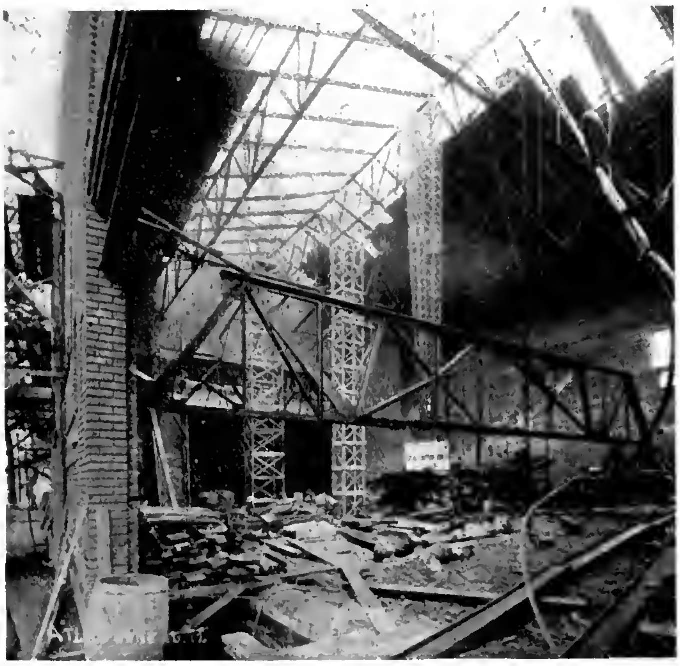
Montreal Theatre the Last Word in Design and Architecture

TO-DAY theatres are sufficiently common not to warrant more than passing attention, as a rule; but this new enterprise of the Loew organization is so novel and replete with originality as to immediately arouse one's interest.

The theatre itself is built on a bed of wet, blue clay, that caused the contractors considerable difficulty. At some points it was necessary to go down 25 feet below the surface to obtain anything like a reasonable foundation. The footings were spread abnormally and reinforced, to overcome the poorness of the sub-soil.

Roof Carried on Trusses

The construction design would be hard to classify under any general system. The main roof is supported by trusses of unusual depth and consequent lightness of section, the transverse trusses being peaked and the longitudinal trusses being of orthodox bridge design. These trusses transmit the loads to the walls, that are strengthened by piers where concentrated stresses occur.



Loew's theatre, Montreal, during construction.

The balcony steel work is so arranged that all the loads are concentrated on the rear wall and two columns on each side of the house, these columns occurring at the side of the aisles. The picture-booth is cantilevered out from the roof trusses, over the bridge crossing the lane, so that a fire in the picture-booth would be entirely outside of the theatre.

The theatre itself is of entirely fireproof construction, only brick, concrete, steel, and metal lath being used. There are a few feet of wood trim on the walls of the auditorium and on the first mezzanine, but that is all. Wherever partitions occur, they are of either brick or terra cotta. In addition to that, the theatre is protected by every fire-fighting system approved by modern practice and experience.

Fire Protection Devices

All the stage area and the dressing-rooms are protected by a sprinkler and stand-pipe system. All doors in this portion of the building are automatically self-closing, and signal boxes are distributed around the whole building and in the St. Catherine Street lobby in such a way that the watchman must make a complete tour of inspection on every round.

A feature that is unusually well treated is the lighting system. The indirect method has been followed, coves being used extensively through the building. Except in the toilets and some of the small rooms, there will not be a single electric lamp visible to the eye. Illuminated panels in the ceilings, of leaded glass, treated with pleasing designs, are distributed where they will give the best effect, and the entire proscenium arch is one bow of light, being made of translucent glass with the design leaded in.

An elaborate system of dimmers has been installed, by means of which the intensity of the lighting throughout the house can be controlled. In this way effects can be made to range from dimmest twilight to brightest day. This will be of great value in interpreting the music, pictures, and acts.

Decorative Treatment

The general decorative style of the theatre is that made famous by the Adams Brothers, the plaster details being carried out in that flat, delicate treatment peculiar to these architects. The wainscotting throughout is of nicely-blended shades of Missisquoi marble, with old rose silk panels above. The tapestries are a rich magenta velour, elaborately embroidered, fringed, and tassellated. The carpet covering all the aisles and crossovers is the color of the wall hangings, with a deep, soft pile. The general feeling of the interior is one of warmth, comfort, and refinement, the last word in art being everywhere visible. The Adams furniture, the fireplaces, the flowers, grandfather's clocks, and the numerous cosy rugs, will give a home-like atmosphere and appearance to this theatre.

The main entrance will be from St. Catherine Street. The patron will step into a marble vestibule beneath a marquise; from thence into the outer lobby, where he will purchase his ticket; thence into the inner lobby, following a slightly-graded floor, which will take him out on to the first mezzanine promenade in the theatre proper.

Promenade a Special Feature

A few words about this promenade may not be out of place. It is elliptical in shape, and the persons first stepping on to it will imagine themselves on a wide gallery such as is found in some European palaces, leading down to an interior court. You face a break in the marble balustrade, and, upon stepping through, find yourself on a broad platform at the head of a marble staircase, which sweeps down in two branches to the orchestra floor, following the elliptical curve of the well hole in the promenade. On this promenade is situated the ladies' and gentlemen's retiring, smoking, and toilet rooms; also the rest room, with its Adams fireplace and easy chairs.

A vomitory leads from each end of the first mezzanine down on to the front of the balcony, from whence one may get to either the loge or the proscenium boxes. Also two flights of stairs lead up to the second mezzanine passage, from which access may be obtained to the upper half of the balcony.

A Second Entrance

There is also a second entrance on Mansfield Street, through which one may step into the orchestra proper, coming in between the feet of the grand staircase, but this will probably be used more for exit purposes than anything else, as it will allow everyone to walk downstairs to get out of the theatre, except the people on the orchestra floor, who will be walking on the level.

The building was designed by Thomas W. Lamb, theatrical architect, of New York, and the construction work is being carried out by the Atlas Construction Company, Ltd., of Montreal.

Water Supply at Port Moody

A Small Town Installation — Source at Small Lakes and Creeks—Comprises About 50,000 feet of Wood Stave Pipe

By M. F. Hill*

THE Canadian Pipe Company, Ltd., of Vancouver, B.C., have successfully completed an up-to-date high-pressure fire protection and domestic service water system for the thriving manufacturing city of Port Moody, B.C. This town is located on the main line of the Canadian Pacific Railway at the head of navigation on Burrard Inlet, about twelve miles east of Greater Vancouver, and has a population of about 1,500 people, with good schools, healthy surroundings, and a large pay-roll.

The new water system presents some very interesting features. At an elevation of about 3,000 feet, and about four miles northeast of the town, a large storage reservoir is formed by damming the outlet of Cypress Lake, which is located on a tributary of Noon Creek, the main source of supply. This lake has an area of 8 1/3 acres, and the dam, which is a rock and earth filled timber crib structure, sheeted on the face with a double thickness of tongue and groove planking, with heavy rubberoid roofing between for tightness, admits of raising the water 11 feet. It will then contain a reserve supply of approximately 50,000,000 gallons, which will provide for several times the present requirements. At present this reserve is allowed to flow as needed down its natural channel to the main intake on Noon Creek, but it is intended eventually to connect the two points with a pipe line to conserve the water.

Scott Creek, another mountain stream flowing parallel with Noon Creek, was also tapped by a concrete core dam resting in hardpan, with screen chambers, provided with 8 in., 6 in., and 4 in. pipe to carry the water to Noon Creek intake, 3,500 ft. distant, and on a grade calculated to handle 350,000 gallons per 24 hours. The Noon Creek intake is a square timber crib, closely built, and filled with rock and earth, faced top and front with 3 in. cedar planking, with screen and intake chambers of ample size and a depth providing an entrance head of 5 ft. Here the waters are mingled and enter the main gravity supply line of 8 in. pipe leading to the town. The grade is very heavy, there being 475 ft. drop in 3,750 ft. At a point 275 ft. above sea level an overflow is provided, and provision made for a service reservoir, which will, no doubt, be a 100,000-gallon wood stave tank when decided on.

Intake dam and screen chambers at Noon Creek 750 ft. above tidewater.

From this overflow point a 10 in. main leads down to the city. The first distribution lateral is an 8 in. main, 3,800 feet in length, extending along the north shore of the harbor, and serves the lumber and shingle plants of that district. The second lateral taken off the 10 in. main is also 8 in., and serves the big steel rolling mills of the Vulcan Iron Works, one of the latest of Port Moody's industries.

Continuing to the city proper and the manufactur-

* Field Superintendent, Canadian Pipe Co., Limited.

ing district, the 10 ft. main follows the waterfront streets and provides excellent fire protection, with 120 pounds pressure per square inch, with 6 in. two-way Ludlow type hydrants set at intervals of about every 250 feet.

For service reservoir and circulation a 100,000-gallon wood stave tank of British Columbia fir stands at the same level, but on the opposite side of the bay from the overflow previously described, the overflow being about equal at each point. This tank is connected on the 10 in. main, and provides the emergency supply. From the centre of the town, where the 10 in. main ends, an 8 in. main extends around the bay and west to the British Columbia Oil Refinery, a distance of about 1½ miles, providing excellent fire service for that large plant, as well as for the lumber industries in that section of the town.

Wire-Wound Wood Stave Pipe Used

In addition to the city system, which consists of 13,000 ft. of 10 in. wire-wound wood stave pressure pipe, 12,000 ft. of 8 in. pipe of the same kind, also 7,000 ft. of 10 in., 8 in., 6 in., and 4 in., same kind, for gravity lines, with 8,000 ft. of 2 in. wood pipe for scattered residential domestic services, the Canadian Pipe Company installed several thousand feet of specially-built wood pipe on the tide flats under the mill properties of the Thurston-Flavelle Lumber Company, Port Moody Shingle Company, and Sardis Shingle Company, for fire protection purposes.

About 10,500 feet of 6 in. steel distribution mains on the higher levels are included in the system, while some 50 hydrants furnish excellent service in that line.

All city services are installed on the meter system, with low rates and high rebate for advance payment.

The Canadian Pipe Company, Ltd., who installed this system, make a specialty of catering to the requirements of cities and municipalities in the way of complete waterworks and other utilities where hydraulic features are involved.

Building Experimental Roads with Various Reinforcements

THE Wisconsin state highway department and the Milwaukee county highway department decided some time ago that they would do some experimenting as regards reinforcing of concrete. Mr. H. J. Kuelling writes of the experiments in "Concrete": The idea is, of course, to prevent as much as possible the formation of longitudinal cracks in the highway. No attempt will be made to prevent transverse cracks, as these are not considered destructive to a highway. As the matter of cost is the main item in reinforcing, the highway department deemed it advisable to give a good deal of attention to the comparison of a thinly reinforced road with the standard non-reinforced road. For that reason, on a good many of the reinforced slabs, the thickness was reduced 1 in. or, in other words, the pavement will be made 5 ins. thick at the edges and 7 ins. thick in the centre, whereas on the standard cross-section the pavement is 6 ins. at the edges and 8 ins. at the centre.

Six ½-mile sections were selected from the mileage to be built in 1917, and these sections were picked out in places having the worst conditions.

Four types of reinforcing were selected for the experiments, as follows:

Rib metal material which will weigh about 48 lbs. per square; some Clinton wire cloth weighing 30.8 lbs. per square; some Clinton wire cloth weighing 21.7 lbs. per square, and some plain rods ⅝ in. square. The six ½-mile sections are to be built as follows:

One ½ mile will be in 50-ft. slabs, with alternate slabs reinforced. One-half of the reinforced slabs are to have the centre 10 feet reinforced with rib-metal and the other half of the reinforced slabs are to have the centre 12 feet reinforced with rib-metal. The thickness of the reinforced slabs in this section is to be 5 ins. at the edges and 7 ins. at the centre, while the non-reinforced slabs are to be 6 ins. at the edges and 8 ins. at the centre.

The second half mile of road will be in 50-ft. sections, with every other slab reinforced with Clinton wire cloth weighing 30.8 lbs. per square. One-half of the reinforced sections are to be reinforced in the centre 10 ft. and half in the centre 12 ft. The thickness of the reinforced slabs is to be 5 ins. at the edges and 7 ins. at the centre, and the non-reinforced sections 6 ins. at the edges and 8 ins. in the centre.

The third half-mile section is to be reinforced with Clinton wire cloth weighing 21.7 lbs. per square. It will be made in 50-ft. sections, with every other slab reinforced. One-half of the reinforced slabs will be reinforced in the centre 10 ft. and half in the centre 12 ft. The thickness of the slabs in this half mile is to be 6 ins. at the edges and 8 ins. in the centre.

The fourth half-mile section will be made in 50-ft. slabs reinforced with ⅝-in. rods in alternate sections. One-half of the reinforced slabs will be reinforced in the centre 12 ft. and the other half are to be reinforced with 10-ft. bars staggered 2 ft. The thickness of the reinforced slabs in this case is to be 5 ins. at the edges and 7 ins. at the centre, while the non-reinforced slabs are to be 6 ins. at the edges and 8 ins. in the centre.

Rib Metal Reinforcing

The fifth half-mile section will be reinforced with rib-metal weighing 48 lbs. per square, and will be made in sections 500 ft. long, three sections being reinforced and two being plain, the reinforced sections having the centre 12 ft. reinforced. The thickness will be 5 ins. at the edges and 7 ins. at the centre of the reinforced slabs and 6 ins. at the edges and 8 ins. at the centre for the non-reinforced slabs.

The sixth and last half-mile section is to be reinforced with rib-metal and is to be in four 400 ft. reinforced sections and three plain sections of 400 ft. each. The reinforced sections are to have the centre 12 ft. reinforced. On two sections the reinforcing is to be 2 ins. from the top and the other two are to have the reinforcing 2 inches from the bottom. The thickness of the reinforced sections is to be 5 ins. at the sides and 7 ins. in the centre, while the plain sections will be 6 ins. at the edges and 8 ins. in the centre.

One reason for using the rib-metal is that practically all of the metal could be used in the one direction and still have the material assembled in sheets. This is also true to a certain extent, of the Clinton wire cloth.

On this experimental work it is the intention of the state department to have a first class engineer present at all times who will be able to keep the data not only on the placing of the reinforcing, but also on the condition of the sub-grade and water content and curing. It is believed that after a couple of winters some interesting information will be gathered from this series of tests.

Treating Roads with Bituminous Materials

Bulletin Issued by Ontario Department of Highways Contains Recommendations Regarding Methods of Applying Surface Treatments

By G. Cameron Parker*

THE success attending the use of bituminous materials depends to a great extent on not only the proper selection of the materials to be used, but on the uniformity of supply. For this reason not only should the available materials be subjected to tests which determine their characteristics and thus render the choice more reliable, but shipments received from time to time should be sampled and tested in order that the supply of material of the desired quality may be assured.

The Department of Public Highways has established a bituminous materials laboratory for the purpose of conducting tests on these materials for the municipalities operating under the highway legislation of the province, and has published specifications for road oils, penetration asphalts and refined tars, which are recommended to these municipalities for use in the purchasing of materials for the different classes of work.

While a number of failures in the use of surface treatments of bituminous materials have been due to the use of unsuitable materials, a greater number of poor results can be attributed to carelessness and lack of knowledge in connection with the methods of application. A good material will seldom if ever produce the desired results with improper handling, while a material of inferior quality, if carefully and properly used will, in many cases, give fair service. The strictest adherence to the principles involved in the application of these materials is necessary if success is to be attained in their use.

Cold Surface Treatments

In the case of newly built macadam roads it is not advisable to apply the bituminous material immediately following the completion of construction. The reason for this is the fact that the covering of the surface with a waterproof material prevents moisture from being absorbed into the surface and forming the required bond. While the water applied during the final stages of construction is essential, a new road derives great benefit from occasional showers of rain and moisture absorbed from the atmosphere.

While it is impossible to set forth any definite rule, no two sets of conditions being the same, it is generally understood that the macadam road should have carried traffic for at least one month prior to the application of even a cold surface treatment. This gives the bond in the road time to set up and any settlement in the surface will become apparent and can be rectified before the oil or tar is applied.

The fact that the road is eventually to be treated does not relieve the superintendent or foreman from any responsibility in connection with the details of construction. It is an infallible rule that the better the road is built the greater will be the effects of bituminous applications. The assumption that the material to be applied will aid in the bonding of the road surface is a forerunner of failure, as experience has proved. Nor will the application of these materials be effective in the case of an old road unless the surface is in a proper state of repair. The time to fill ruts and depressions is before the bituminous treatment, not afterwards.

Clean Surface Essential

A clean surface is essential; tar or oil applied to the road over a layer of dust and dirt is wasted and occasion discomfort instead of comfort to the travelling public. Surface treatments are for the prevention of the formation of dust as well as for the prevention of its removal from the road. Consequently, if the material is applied to a dusty road it is impossible for it to come in contact with the hard surface and its effect is almost entirely lost.

If the road to be treated is wide enough for two lines of traffic, one half should be closed and signs posted stating that the road is being oiled and instructing traffic to proceed with caution. In the case of narrow roads they should be entirely closed to traffic for short stretches at a time and provision made for detours. It is impossible to properly apply bituminous materials on a road that is carrying traffic.

Providing the surface requires no repairs, or that these have been made, the road should be thoroughly swept. This does not mean a light sweeping with hand brooms, which removes the loose dust only, but a thorough cleaning, which removes not only the loose material from the surface, but also the dust and binder from around the top of the stone in the surface. Stiff stable brooms can be used, but better results will attend the use of a horse-drawn street sweeper with a revolving brush. One sweeping should not be considered sufficient, but the operation should be repeated until the mosaic on the surface stands out clean and clear. Not till then is the surface ready for the tar or oil.

The materials usually come in tank cars of from 6,000 to 8,000 gallons capacity, except in the case of small shipments when the material is put up in barrels or steel drums. In the majority of cases tank car shipments are made.

Distributor to Apply Material

In applying fluid bituminous materials a distributor wagon should be used; a water sprinkling tank is suitable but will have to be fitted with a spraying attachment with a control valve and openings of sufficient size to allow the uniform distribution of the material in the desired quantity. The length of the distributor should be sufficient to cover the entire surface in the case of very narrow roads, or shorter, in order that the application can be made in two or more strips on wide roads. There should not, however, be any part of the surface uncovered, and the distributor should always travel in one direction.

The applications should be made during warm weather, when the road is thoroughly dry and there is no indication of rain. While warm, the material will spread more uniformly and in the absence of moisture will penetrate and adhere more strongly to the road surface.

The quantity of material applied will depend on

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the grade used and the condition of the surface. From one-fifth to one-quarter of an imperial gallon per square yard is the usual amount. A stretch of road should be measured, the area calculated, and the valve on the distributor regulated till the desired application is obtained. Experience is the best guide in this matter.

The advisability of applying a coating of clean sand or fine gravel will also depend on the conditions mentioned above. With some materials it has not been found necessary; with others it is required, in order to prevent the material adhering to the tires of the vehicles. Where it is applied, a period of several hours should elapse between the application of the oil or tar and the spreading of the sand, in order that the bituminous material may spread over and penetrate the road and "seal up." The sand when applied will then absorb any excess material and permits the road being opened to traffic earlier than when it is not used.

Hot Surface Treatments

The principle governing the successful use of materials for cold surface treatments are the same when the materials used are of such consistency that they require preheating. The chief difference is in the method of application.

Where small stretches of road are to be treated the material may be applied by hand. It will usually be shipped in drums or barrels and can be heated in small portable heating kettles, of which there are a number of types, and applied with hand sprinklers. Usually, however, the work is of such a size that tank car quantities are purchased and distributing wagons used. In this case it is advisable that the material be applied under pressure as by this means a greater bond with the surface of the road is obtained and the scrubbing action of the spray cleans the minute particles of dust, which it is impossible to remove otherwise, from the road.

The tank cars in which hot application materials are shipped are fitted with interior steam coils in order that the material may be heated quickly. It will be necessary to provide a small steam boiler, of approximately 20 h.p. capacity, at the siding and connect it to the heating coils of the car. The length of time required to render the material sufficiently fluid to be transferred to the distributing wagon is approximately 48 hours, the transfer of the material to the distributor being accomplished by applying steam pressure to the top of the tank and attaching a pipe from the bottom of the tank to the distributor.

Distribution Methods

Distributing wagons are self-propelled or are designed to be drawn by the roller and are provided with heating coils to which the boiler of the roller is connected. This keeps the material hot and at the same time steam is utilized to secure the desired pressure at the nozzles.

The distributing arrangement may be in the form of nozzles which are controlled by valves, and apply the material in the form of fan-like jets; an ordinary sprinkler, or a hose with a nozzle may be attached to the distributing wagon and guided by hand. In each case skill and experience are necessary to obtain the proper application.

The quantity used in hot surface treatments may vary from one-quarter to one-half an imperial gallon per square yard of surface. The grade of material used, the condition of the road, and the thickness of carpet desired will govern this.

Shortly after the application of the material, as soon as it has had time to "seal up," the surface should be covered with a layer of pea gravel, clean stone screenings or very coarse, clean sand. This should be applied in small quantities and spread uniformly, an excess being avoided. The result should be a thin mat or carpet on the surface composed of the bituminous material and the fine aggregate.

A thick bituminous coat is not desirable as experience has shown that it will not adhere uniformly to the surface and will wave and shove under traffic. Better practice recommends successive applications in small quantities, which results in retaining on the surface of the road a thin, tough, impregnated film.

Surface Binders—Penetration Method

A bituminous surface, constructed by the penetration method may be laid either on a new foundation or on an old macadam road, the traffic on which demands a surface of this type. If the entire work is new the bottom course of the road should be constructed according to the methods indicated in Publication No. 8 of the Department, entitled "Principles of Roadmaking." In the case of a road which has been under traffic for a number of years with resulting ruts and depressions the surface should be lightly scarified; with the grading machine the contour should be reformed; new stone or gravel applied; and rolling continued until an even, dense surface is obtained. On such a foundation a new wearing course, carefully constructed, will give excellent service.

Crushed stone of a size commonly known as "two-inch," but which should be more definitely specified as material, all of which will pass a 2¼-inch circular opening and be retained by a 1½-inch circular opening, should be used for the surface. The compacted depth of the surface course should be, in general, three inches, but, as circumstances will decide, a greater depth may be advisable. The minimum depth, however, should not be less than three inches. The material should be spread on the surface of the foundation evenly and well compacted with a roller weighing at least ten tons. All unevenness and depressions should be eliminated and the surface brought to an even grade and crown. It is then ready for the application of the bituminous binder.

Binders Must Be Heated

Binders are solid at ordinary temperatures, and will, therefore, require heating before they can be handled. They will be shipped in tank cars fitted with internal heating coils and should be heated in the same manner as hot surfacing materials. The temperature to which asphaltic binders should be heated is between 200 and 300 degrees Fahrenheit, and that for tar binders should be lower, between 200 and 250 degrees Fahrenheit. The upper limit of temperature should not be exceeded as there is danger of injuring the material when this is done.

In order to obtain a penetration to as great a depth as possible a pressure distributor should be used, pressure being obtained by means of a pump, in the case of self contained distributors, or by steam, when a distributing wagon is drawn behind the roller. Pressures used will vary with the type of distributor but should be in the neighborhood of 50 pounds per square inch.

When it is necessary to apply the material in successive strips great care must be taken that the strips do not overlap to any great extent as an excess of material will form a narrow ridge in the centre. On the other hand, there should not be a strip of the surface which has not received the proper amount of material. A method which has been used with success to avoid these two objectionable conditions consists of laying a strip of heavy building paper at the edge of the first application and overlapping with the second application. The paper is then removed and destroyed.

Proper Thickness

The amount of material which should be applied will be in proportion to the thickness of the surface. For a compacted surface three inches thick the amount of bituminous material required to fill the voids is approximately 1½ imperial gallons per square yard of surface. When the surface course is greater than three inches in thickness the amount of binder should be increased in proportion.

This should be followed by a thin layer of clean, crushed stone, all of which passes a 1½-inch circular opening and is retained by a ¾-inch or ⅝-inch circular opening. It should be spread uniformly and rolled with a 10-ton roller until it is thoroughly compacted, fills the voids in the larger stone, and the surface is even and true to grade and crown.

In some instances a seal coat of material, at the rate of ¼ to ½ of an imperial gallon per square yard, is used, being applied after the small stone has been rolled and all the loose material swept off the surface. The use of a seal coat is, however, not universal, and the question of its application should be decided by the engineer or superintendent.

Maintenance of Bituminous Surfaces

Expenditure on bituminous treatments, in order to be effective, must be followed by a comprehensive scheme of maintenance. The fact that a road has received an application of bituminous material does not relieve those in charge from the responsibility of keeping it up to the required standard. The effects of bituminous treatments are cumulative; successive applications increasing the traffic resisting properties of the road. Even cold applications, if made at proper intervals and accompanied by attention to small defects during the intervening periods, will eventually result in an impregnated surface on which it is a pleasure to travel. On the other hand, the neglect to properly maintain a bituminous surface of any type will cause the road to deteriorate and reflect discredit, not only on the materials used, but on the municipality and the official directly responsible.

One of the first steps towards the maintenance of a road consists of depositing piles of crushed stone, of one or more sizes, at intervals on the roadside during the period of construction. Material will thus be available when needed in small quantities for the repairing of minor defects.

Patrol System Most Effective

The patrol system has been found the most effective, and at the same time the most economical method for the upkeep of rural highways. It is an arrangement which lends itself to adjustment, according to the demands of traffic. A patrolman is appointed to supervise a certain section of the road, the length to be patrolled depending on the amount of time and labor required to keep the road in the proper state of repair. He should be furnished with a complete equipment consisting of a single horse wagon, shovel, rake, scythe, pick, coarse stable broom, iron tamper, pouring can and portable heating kettle.

Holes and ruts which develop should be picked out until all loose material is removed and the sides are solid and perpendicular. They should be swept free from all dirt in order that the new material may adhere to the solid portion of the road. The bottom and sides should then be painted with the hot bituminous material and the holes filled with clean crushed stone. This should be compacted with the iron tamper and the hot bituminous material poured over it with the pouring can until the spaces are well filled. If smaller stone is available it should be spread over the surface and again tamped, but in its place sand or the dust from the road surface can be swept over the repair and the whole again thoroughly tamped. Care must be taken that the material is even with the surface of the road or not sufficiently above it to produce a "bump."

Repaired sections should be the same in character as the main portion of the road. The stone or gravel should be of the same size and quality as that used in the original construction and similar grades of bituminous material should be used.

Bridges on Toronto Suburban Railway Line

THE Toronto Suburban Railway have just recently placed in operation the extension of their line from Lambton, Ont., west to Guelph. The length of the new line is 46.3 miles. It connects with the existing service operating from Lambton to Toronto. The extension is operated electrically at 1,500 volts d.c. The construction of the roadway and overhead system follows standard practice in general. There are a great number of bridges, large and small, throughout the length of the line, which are of interest. They are generally of steel and concrete, with a number of frame and pile trestle bridges at the less important streams. With the exception of the Humber River bridge, they are designed for class 2 loading of the Department of Railways and Canals specifications. The Humber Valley bridge, which is the most important structure on the new road, was designed for class heavy loading of the Department of Railways and Canals specifications. The illustrations reproduced herewith show typical constructions.

Large Structure Over Humber River

The Humber River bridge, shown in Fig. 1, is located a half-mile west of Lambton. Its total length is 711 feet and the maximum height above the bed of the river is 86 feet. The eastern portion, 209 feet in length, is of frame trestle on mud sills. A high pier at the end of the trestle part also carries the first steel spans. This pier is of somewhat unusual construction. It is 55 feet high to the bridge seat, which measures 14 x 7½ feet in plan. The ends and sides are battered in the proportion of 1 in 24 and 1 in 18 respectively. In order to lessen the amount of concrete an opening 30 feet high and 5 feet wide was left in the pier from front to back, commencing 7 feet above the footing. As the slope of the embankment comes against the back of the pier 35 feet above the footing, a counterfort was built on each side of this opening. These counterforts are 3 feet wide, and commence in the face of the pier, 24 feet above the footing. They are battered out 1 in 4, giving them a thickness or projection beyond the neatwork of 4 feet 8 inches in the top of footing.

The balance of the bridge is of deck-plate girder construction on steel trestle towers. The tower spans are 40 ft. 4 in. and the mid-spans are 95 ft. 2 in., 95 ft. 4 in., 95 ft. 4 in., and 85½ ft. The towers are carried on concrete piers or pedestals, carried to solid rock. The land tower is supported on four pedestals 6 ft. square on top. The river towers rest on two piers 39½ ft. x 6 ft., carried full size to above high-water level, and then an additional 4 ft. in the form of a pedestal at the end of the pier. There is a 90 degrees cut water on each end of each pier. The west abutment, which is of ordinary wing construction, is founded on stiff clay.

Credit River Bridge

The bridge illustrated in Fig. 2 crosses the Credit River and comprises three plate-girder spans, one 40 ft. long and two 80 ft. long. The 40 ft. span is over an old tail-race, and is supported on two concrete abutments. The two 80 ft. spans are over the main river, and are supported on two concrete abutments and one pier. The clearance is 12 ft.

Fig. 3 illustrates a typical wood trestle bridge crossing the West Credit River. The total length of this particular structure is 315 ft. and the maximum height is 54 ft. The trestles are partly on mud sills and partly on crib-work piers.

Fig. 1—Steel trestle bridge over Humber River on line of Toronto Suburban Railway.
Fig. 2—Through plate girder spans over Credit River.
Fig. 3—A typical wood trestle bridge.

Many Types of Structures Used

Some details of other bridges on the line follow:

Mimico Creek bridge.—80 ft. through plate-girder, on concrete piers and abutments, 14 ft. from bed of stream to base of rail. This bridge is in a bad location, owing to the angle at which it crosses the stream and to the sharp curvature of the track. In order to ease the flow of the stream the river was widened on the east side and protected with a sheet pile bulkhead for 180 ft. upstream from the bridge. A short bulkhead was also built on the downstream side of the east abutment, and the banks on both sides were further protected with heavy rip-rap. Both abutments are founded on gravel, in which no piling was necessary.

Etobicoke River bridge.—Two 50 ft. through plate-girders on two concrete abutments and one pier. Bed of stream to base of rail 12 ft. Both abutments and pier are on solid rock foundation.

Dundas Street overhead bridge.—Reinforced concrete construction. Two abutments supporting slab on which the road is carried. Clear span 16 ft., at right angles to centre line of railway. Bridge on 47 degrees skew. Clear height, top of rail to trolley wire, 16 ft.

Dixie Creek.—Timber trestle on mud sills 165 ft. long. Maximum height 23 ft.

Creek at mileage 10.3.—Timber trestle on mud sills 35 ft. long. Maximum height 7 ft.

Creek at mileage 14.2.—Timber trestle on crib piers; 90 ft. long. Maximum height, 20 ft.

C.P.R. crossing at mileage 15.8.—The C.P.R. is crossed underneath, and an I-beam bridge, on concrete abutments, was built to carry the C.P.R. track. The width at right angles to the Toronto Suburban Railway track is 16 ft. in the clear, and the clear height 15 feet.

West Credit River.—410 ft. timber trestle on piles. Maximum height above bed of stream 32 ft. This trestle is extended on the west, with a three-span I-beam bridge on two abutments and two pairs of pedestals, to carry the railway over Water Street, Georgetown. This bridge consists of two 16 and one 24 ft. spans, giving a clearance above the roadway of 14½ feet.

Overhead Bridge at C.P.R. Crossing

The G.T.R. Hamilton and Northwestern branch is crossed at mile 26.7, underneath, and a bridge of I-beams, on concrete piers, with a clear span at right angles to the Toronto Suburban Railway of 16 ft., was built to carry the G.T.R. track. Clearance from rail to trolley wire under the bridge 16 ft.

West fork of west branch of Credit River.—Timber trestle 270 ft. long, on mud sills, and where in the river on timber cribs. Maximum height 45 ft.

Limehouse Creek.—Pile trestle 180 ft. long. Height above bed of creek 8 ft.

Frame trestle, 180 ft. long, on mud sills, over Toronto Lime Company's plant at Dolly Varden Mine. Total height 13 ft.

Creek at mileage 31.3.—Pile trestle 60 ft. long. Maximum height 17 ft.

Creek at mileage 32.8.—Frame trestle on piles 75 ft. long. Maximum height 18 ft.

Fairy Lake.—Pile trestle 180 ft. long. Maximum height 14 ft.

Blue Springs Creek.—Pile trestle 75 ft. long. Maximum height 8 ft.

Speed River.—80 ft. through plate-girder on concrete abutments. Bed of stream to base of rail 10 ft. Abutments founded on coarse gravel and boulders.

Reinforced Concrete Flat Slab Design

Recommendations of Joint Committee Covering Important Features of This Type of Construction

FLAT SLAB

The continuous flat slab reinforced in two or more directions and built monolithically with the supporting columns (without beams or girders) is a type of construction which is now extensively used and which has recognized advantages for certain types of structures as, for example, warehouses in which large, open floor space is desired. In its construction, there is excellent opportunity for inspecting the position of the reinforcement. The conditions attending depositing and placing of concrete are favorable to securing uniformity and soundness in the concrete. The recommendations in the following paragraphs relate to flat slabs extending over several rows of panels in each direction. Necessarily the treatment is more or less empirical.

The coefficients and moments given relate to uniformly distributed loads.

Column Capital

It is usual in flat slab construction to enlarge the supporting columns at their top, thus forming column capitals. The size and shape of the column capital affect the strength of the structure in several ways. The moment of the external forces which the slab is called upon to resist is dependent upon the size of the capital; the section of the slab immediately above

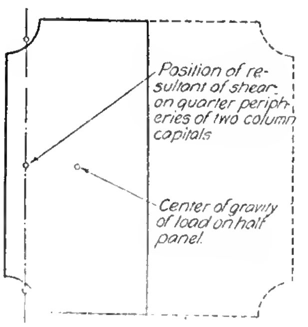


Fig. 1

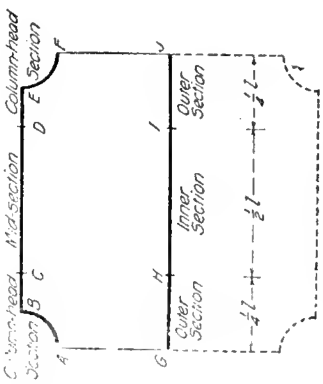


Fig. 2

the upper periphery of the capital carries the highest amount of punching shear; and the bending moment developed in the column by an eccentric or unbalanced loading of the slab is greatest at the under surface of the slab. Generally the horizontal section of the column capital should be round or square with rounded corners. In oblong panels the section may be oval or oblong with dimensions proportional to the panel dimensions. For computation purposes, the diameter of the column capital will be considered to be measured where its vertical thickness is at least 1½ inches, provided the slope of the capital below this point nowhere makes an angle with the vertical of more than 45 degs. In case a cap is placed above the column capital, the part of this cap within a cone made by extending the lines of the column capital upward at the slope of 45 degs. to the bottom of the slab or dropped panel may be considered as part of the column capital in determining the diameter for design purposes. Without attempting to limit the size of the column capital for special sizes, it is recommended that the diameter of the column capital (or its dimension parallel to the edge of the panel) generally be made not less than one-fifth of the dimension of the panel from centre to centre of adjacent columns. A diameter equal to 0.225 of the panel length has been used quite widely and acceptably. For heavy loads or large panels especial attention should be given to designing and reinforcing the column capital with respect to compressive stresses and bending moments. In the case of heavy loads or large panels, and where the conditions of the panel loading or variations in panel length or other conditions cause high bending stresses in the column, and also for column capitals smaller than the size herein recommended, special attention should be given to designing and reinforcing the column capital with respect to compression and to rigidity of connection to floor slab.

Dropped Panel

In one type of construction the slab is thickened throughout an area surrounding the column capital. The square or oblong of thickened slab thus formed is called a dropped panel or a drop. The thickness and the width of the dropped panel may be governed by the amount of resisting moment to be provided (the compressive stress in the concrete being dependent upon both thickness and width), or its thickness may be governed by the resistance to shear required at the edge of the column capital and its width by the allowable compressive stresses and shearing stresses in the thinner portion of the slab adjacent to the dropped panel. Generally, however, it is recommended that the width of the dropped panel be at least four-tenths of the corresponding side of the panel as measured from centre to centre of columns, and that the offset in thickness be not more than five-tenths of the thickness of the slab outside the dropped panel.

Slab Thickness

In the design of a slab, the resistance to bending and to shearing forces will largely govern the thickness, and, in the case of large panels with light loads, resistance to deflection may be a controlling force. The following formulae for minimum thicknesses are recommended as general rules of design when the diameter of the column capital is not less than one-fifth of the dimension of the panel from centre to centre of adjacent columns, the larger dimension being used in the case of oblong panels. For notation, let

t = total thickness of slab in inches.
L = panel length in feet.
w = sum of live load and dead load in pounds per square foot.

Then, for a slab without dropped panels, minimum $t = 0.024\,L\sqrt{w} + 1\frac{1}{2}$; for a slab with dropped panels; minimum $t = 0.02\,L\sqrt{w} + 1$; for a dropped panel whose width is four-tenths of the panel length, minimum $t = 0.03\,L\sqrt{w} + 1\frac{1}{2}$.

In no case should the slab thickness be made less than six inches, nor should the thickness of a floor slab be made less than one-thirty-second of the panel length, nor the thickness of a roof slab less than one-fortieth of the panel length.

Bending and Resisting Moments in Slabs

If a vertical section of a slab be taken across a panel along a line midway between columns, and if another section be taken along an edge of the panel parallel to the first section, but skirting the part of the periphery of the column capitals at the two corners of the panels, the moment of the couple formed by the external load on the half panel, exclusive of that over the column capital (sum of dead and live load) and the resultant of the external shear or reaction at the support at the two column capitals (see Fig. 1), may be found by ordinary static analysis. It will be noted that the edges of the area here considered are along lines of zero shear except around the column capitals. This moment of the external forces acting on the half panel will be resisted by the numerical sum of (a) the moment of the internal stresses at the section of the panel midway between columns (positive resisting moment) and (b) the moment of the internal stresses at the section referred to at the end of the panel (negative resisting moment). In the curved portion of the end section (that skirting the column), the stresses considered are the components which act parallel to the normal stresses on the straight portion of the section. Analysis shows that, for a uniformly distributed load, and round columns, and square panels, the numerical sum of the positive moment and the negative moment at the two sections named is given quite closely by the equation

$$Mx = 1/8\ wl\ (1-2/3c)^2.$$

In this formula and in those which follow relating to oblong panels,

- w=sum of the live and dead load per unit of area;
- l =side of a square panel measured from centre to centre of columns;
- l_1=one side of the oblong panel measured from centre to centre of columns;
- l_2=other side of oblong panel measured in the same way;
- c =diameter of the column capital;
- Mx=numerical sum of positive moment and negative moment in one direction;
- My=numerical sum of positive moment and negative moment in the other direction.

For oblong panels, the equations for the numerical sums of the positive moment and the negative moment at the two sections named become,

$$Mx=1/8\ wl_2\ (l_1-2/3c)^2$$
$$My=1/8\ wl_1\ (l_2-2/3c)^2$$

where Mx is the numerical sum of the positive moment and the negative moment for the sections parallel to the dimension l_2, and My is the numerical sum of the positive moment and the negative moment for the sections parallel to the dimension l_1.

What proportion of the total resistance exists as positive moment and what as negative moment is not readily determined. The amount of the positive moment and that of the negative moment may be expected to vary somewhat with the design of the slab. It seems proper, however, to make the division of total resisting moment in the ratio of three-eighths for the positive moment to five-eighths for the negative moment.

With reference to variations in stress along the sections, it is evident from conditions of flexure that the resisting moment is not distributed uniformly along either the section of positive moment or that of negative moment. As the law of the distribution is not known definitely, it will be necessary to make an empirical apportionment along the sections; and it will be considered sufficiently accurate generally to divide the sections into two parts and to use an average value over each part of the panel section.

The relatively large breadth of structure in a flat slab makes the effect of local variations in the concrete less than would be the case for narrow members like beams. The tensile resistance of the concrete is less affected by cracks. Measurements of deformations in buildings under heavy load indicate the presence of considerable tensile resistance in the concrete, and the presence of this tensile resistance acts to decrease the intensity of the compressive stresses. It is believed that the use of moment coefficients somewhat less than those given in a preceding paragraph as derived by analysis is warranted, the calculations of resisting moment and stresses in concrete and reinforcement being made according to the assumptions specified in this report and no change being made in the values of the working stresses ordinarily used. Accordingly, the values of the moments which are recommended for use are somewhat less than those derived by analysis. The values given may be used when the column capitals are round, oval, square, or oblong.

Names for Moment Sections

For convenience, that portion of the section across a panel along a line midway between columns which lies within the middle two quarters of the width of the panel (HI, Fig. 2) will be called the inner section, and that portion in the two outer quarters of the width of the panel (GH and IJ, Fig. 2) will be called the outer sections. Of the section which follows a panel edge from column capital to column capital and which includes the quarter peripheries of the edges of two column capitals, that portion within the middle two quarters of the panel width (CD, Fig. 2) will be called the mid-section, and the two remaining portions (ABC and DEF, Fig. 2), each having a projected width equal to one-fourth of the panel width, will be called the column-head sections.

Positive Moment

For a square interior panel, it is recommended that the positive moment for a section in the middle of a panel extending across its width be taken as 1/25 wl $(1-2/3c)^2$. Of this moment, at least 25 per cent. should be provided for in the inner section; in the two outer sections of the panel at least 55 per cent. of the specified moment should be provided for in slabs not having dropped panels, and at least 60 per cent. in slabs having dropped panels, except that in calculations to determine necessary thickness of slab away from the dropped panel at least 70 per cent. of the positive moment should be considered as acting in the two outer sections.

Negative Moment

For a square interior panel, it is recommended that the negative moment for a section which follows a panel edge from column capital to column capital and which includes the quarter peripheries of the edges of the two column capitals (the section altogether forming the projected width of the panel) be taken as 1/15 wl $(1-2/3c)^2$. Of this negative moment, at least 20 per cent. should be provided for in the mid-section and at least 65 per cent. in the two column-head sections of the panel, except that in slabs having dropped panels at least 80 per cent. of the specified negative moment should be provided for in the two column-head sections of the panel.

Moments for Oblong Panels

When the length of a panel does not exceed the breadth by more than 5 per cent., computation may be made on the basis of a square panel with sides equal to the mean of the length and the breadth.

When the long side of an interior oblong panel exceeds the short side by more than one-twentieth and by not more than one-third of the short side, it is recommended that the positive moment be taken as $1/25\ wl_2\ (l_1—2/3\ c)^2$ on a section parallel to the dimension l_2 and $1/25\ wl_1\ (l_2—2/3\ c)^2$ on a section parallel to the dimension l_1; and that the negative moment be taken as $1/15\ wl_2\ (l_1—2/3\ c)^2$ on a section at the edge of the panel corresponding to the dimension l_2, and $1/15\ wl_1\ (l_2—2/3\ c)^2$ at a section in the other direction. The limitations of the apportionment of moment between inner section and outer section and between mid-section and column-head sections may be the same as for square panels.

Wall Panels

The coefficient of negative moment at the first row of columns away from the wall should be increased 20 per cent. over that required for interior panels, and likewise the coefficient of positive moment at the section half way to the wall should be increased by 20 per cent. If girders are not provided along the wall or the slab does not project as a cantilever beyond the column line, the reinforcement parallel to the wall for the negative moment in the column-head section and for the positive moment in the outer section should be increased by 20 per cent. If the wall is carried by the slab this concentrated load should be provided for in the design of the slab. The coefficient of negative moments at the wall to take bending in the direction perpendicular to the wall line may be determined by the conditions of restraint and fixedness as found from the relative stiffness of columns and slab, but in no case should it be taken as less than one-half of that for interior panels.

Reinforcement

In the calculation of moments all the reinforcing bars which cross the section under consideration and which fulfil the requirements given under "Arrangement of Reinforcing," below, may be used. For a column-head section reinforcing bars parallel to the straight portion of the section do not contribute to the negative resisting moment for the column-head section in question. In the case of four-way reinforcement the sectional area of the diagonal bars multiplied by the sine of the angle between the diagonal of the panel and the straight portion of the section under consideration may be taken to act as reinforcement in a rectangular direction.

Point of Inflection

For the purpose of making calculations of moments at sections away from the sections of negative moment and positive moment already specified, the point of inflection on any line parallel to a panel edge may be taken as one-fifth of the clear distance on that line between the two sections of negative moment at the opposite ends of the panel indicated in paragraph re names for moment sections, above. For slabs having dropped panels the coefficient of one-fourth should be used instead of one-fifth.

Arrangement of Reinforcement

The design should include adequate provision for securing the reinforcement in place so as to take not only the maximum moments but the moments at intermediate sections. All bars in rectangular bands or diagonal bands should extend on each side of a section of maximum moment, either positive or negative, to points at least twenty diameters beyond the point of inflection as defined herein or be hooked or anchored at the point of inflection. In addition to this provision bars in diagonal bands used as reinforcement for negative moment should extend on each side of a line drawn through the column center at right angles to the direction of the band at least a distance equal to thirty-five one-hundredths of the panel length, and bars in diagonal bands used as reinforcement for positive moment should extend on each side of a diagonal through the centre of the panel at least a distance equal to thirty-five one-hundredths of the panel length; and no splice by lapping should be permitted at or near regions of maximum stress except as just described. Continuity of reinforcing bars is considered to have advantages, and it is recommended that not more than one-third of the reinforcing bars in any direction be made of a length less than the distance centre to centre of columns in that direction. Continuous bars should not all be bent up at the same point of their length, but the zone in which this bending occurs should extend on each side of the assumed point of inflection, and should cover a width of at least one-fifteenth of the panel length. Mere draping of the bars should not be permitted. In four-way reinforcement the position of the bars in both diagonal and rectangular directions may be considered in determining whether the width of zone of bending is sufficient.

Reinforcement at Construction Joints

It is recommended that: at construction joints extra reinforcing bars equal in section to 20 per cent. of the amount necessary to meet the requirements for moments at the section where the joint is made be added to the reinforcement, these bars to extend not less than 50 diameters beyond the joint on each side.

Tensile and Compressive Stresses

The usual method of calculating the tensile and compressive stresses in the concrete and in the reinforcement, based on the assumptions for internal stresses should be followed. In the case of the dropped panel the section of the slab and dropped panel may be considered to act integrally for a width equal to the width of the column-head section.

Provision for Diagonal Tension and Shear

In calculations for the shearing stress which is to be used as the means of measuring the resistance to diagonal tension stress, it is recommended that the total vertical shear on two column-head sections constituting a width equal to one-half the lateral dimension of the panel, for use in the formula for determining critical shearing stresses, be considered to be one-fourth of the total dead and live load on a panel for a slab of uniform thickness, and to be three-tenths of the sum of the dead and live loads on a panel for a slab with dropped panels. The formula for shearing unit stress will then be written $v=0.25W/bjd$ for slabs of uniform thickness, and v=0.30W/bjd for slabs with dropped panels, where W is the sum of the dead and live load on a panel, b is half the lateral dimension of the panel measured from centre to centre of columns, and jd is the lever arm of the resisting couple at the section.

The calculation of what is commonly called punching shear may be made on the assumption of a uniform distribution over the section of the slab around the periphery of the column capital and also of a uniform distribution over the section of the slab around the periphery of the dropped panel, using in each case an amount of vertical shear greater by 25 per cent. than the total vertical shear on the section under consideration.

Walls and Openings

Girders or beams should be constructed to carry walls and other concentrated loads which are in excess of the working capacity of the slab. Beams should also be provided in case openings in the floor reduce the working strength of the slab below the required carrying capacity.

Unusual Panels

The coefficients, apportionments, and thicknesses recommended are for slabs which have several rows of panels in each direction, and in which the size of the panels is approximately the same. For structures having a width of one, two, or three panels, and also for slabs having panels of markedly different sizes, an analysis should be made of the moments developed in both slab and columns, and the values given herein modified accordingly. Slabs with paneled ceiling or with depressed paneling in the floor are to be considered as coming under the recommendations herein given.

Bending Moments in Columns

Provision should be made in both wall columns and interior columns for the bending moment which will be developed by unequally loaded panels, eccentric loading, or uneven spacing of columns. The amount of moment to be taken by a column will depend upon the relative stiffness of columns and slab, and computations may be made by rational methods, such as the principle of least work, or of slope and deflection. Generally, the larger part of the unequalized negative moment will be transmitted to the columns, and the column should be designed to resist this bending moment. Especial attention should be given to wall columns and corner columns.

Joint Sewage System for Mimico and New Toronto in Operation

THE Joint Sewerage System for Mimico and New Toronto has just been put in operation. This includes a sewage pumping station in Mimico at the corner of Superior Avenue and the Lake Shore Road, and sewage disposal works situated north of the G. T. R. tracks on Grand Avenue, representing an outlay of $26,500. By means of a 30-inch trunk sewer, three miles in length, along the Lake Shore Road, New Toronto is connected with the pump and disposal works in Mimico. Over eight miles of sewerage have been laid by both towns and connections will be made on the local improvement basis. The pumping station, which cost $6,500, is a fireproof structure, built of pressed brick. The pumping machinery consists of two electrically-driven centrifugal pumps, with capacities of 500 and 1,000 gallons per minute respectively, also one gasoline-operated pump with a capacity of 750 gallons, which will be used as an auxiliary unit. Beneath the floor of the station is the well from which the sewage is pumped. It is divided into three compartments, each with an approximate capacity of 2,500 gallons. To connect this building with the disposal works, about one mile distant, a force main 16 inches in diameter was laid. The disposal plant cost $20,000 to construct and consists of four buildings containing sedimentation tanks, sprinkling filters, chlorine disinfecting and humous tanks. It is designed for a capacity of 3,000 connections. All of the buildings are of solid concrete, with either wood or steel roofs, with the exception of the disinfecting plant, which is of brick and concrete. Mr. F. F. Fry, of Toronto, carried out the building contract, and the Toronto Equipment Company installed the machinery. Pipe was supplied by the Ontario Sewer Pipe Company. The plans were drawn and the work supervised by Mr. T. Lowes, of Toronto.

A 57-Storey Hotel and Office Building

Mr. F. Swirsky, architect, of Detroit, Michigan, is preparing plans for a $15,000,000 hotel and office building. The plans are for the tallest building in the world—57 stories—capable of sheltering 10,000 people in hotel rooms and offices.

The building will be a city sufficient in itself, with a post office, police station, arena seating 16,000 people, a quarter mile track, and an auditorium. Plans call for a 27-storey hotel and 57 stories of offices, running up into a tower, 808 feet high, as compared with 789 feet at the Woolworth Building, New York.

Two aeroplane landings 50 feet wide by 620 feet long, will be located on the roof, according to Mr. Swirsky. There will be 4,312 rooms. In the basement will be located 504 display rooms for auto concerns and others. Sixty shops will be located on the first floor.

There will be seven banquet halls, two small convention halls, one serve-self, one dining-room, two ballrooms, and a hospital on the second floor of the building.

Concrete Tanks Stand Up Under Fire

A fire of 24 hours' duration recently destroyed the elevator plant of the Maney Milling Company, at Omaha, Nebr., with the exception of the two reinforced concrete tanks which stood the test. The mills were of wood construction covered in part with sheet iron and were about the same height as the tanks, 150 ft. A wood conveyor house connected the tanks with the elevator.

A strong north wind forced the flames against the concrete bins for nine hours, while at intervals water was thrown against them. The fire continued at less intensity for 24 hours.

The only damage to the tanks is a dehydration and scaling of the concrete near their top for about 1/4 in. in depth, reaching the reinforcing in but one place and that where the steel was too close to the surface. No cracks could be discovered nor was there any bulging through expansion of the steel.

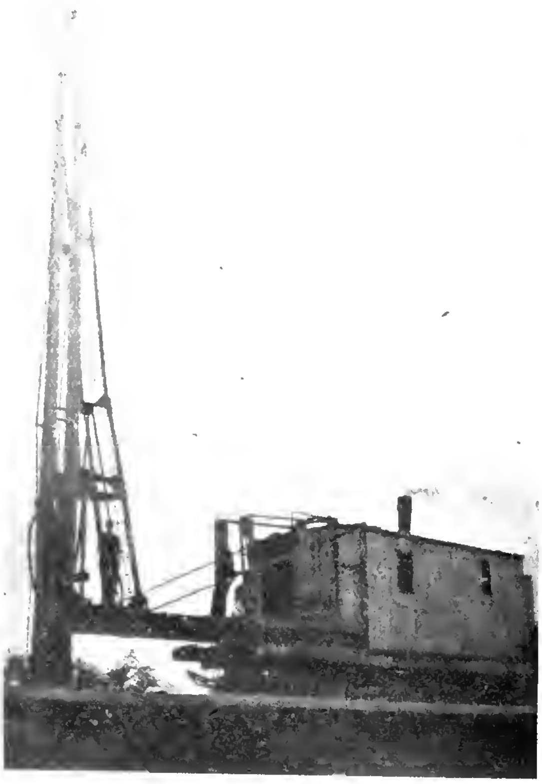
The tanks, which hold 20,000 bushels of wheat each, were one-third full and the grain was found to be in perfect condition. The bins are being repaired by brushing off the scale and applying a coat of cement mortar and preparations are being made to rebuild the elevator with concrete.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Folding Leads on Pile Driver Enable Transportation Without Dismantling

THE construction department of the Grand Trunk Railway System is making use of a specially designed pile driving equipment which is illustrated below. The outstanding feature of this driver is the folding leads which enable transportation of the machine on train or its passage under bridges without dismantling. The illustrations make clear the manner of securing collapsibility and show the driver ready for work, in process of folding, and in transit. It will be seen that the leads of the driver are hinged on a steel frame and raising or lowering is secured simply by movement of the hammer up and down in the lead so that to raise the leads for driving the hammer is moved from the folded up position to the ends of the lead. When raised for driving of piles, the leads are made secure for work by four pins, two in the bottom chord and two in the ladder hinges. As movement of the hammer within the leads performs the raising or lowering, no machinery or lines are necessary for this purpose. Since the motions of the leads and the hammer are perfectly balanced, it is a matter of only a few seconds to either set up ready for work or lower down ready for movement on trains. The hinge is located at the proper height to form a complete balance by lowering the hammer to the lower end of the leads.



Pile driver in position for driving.

Leads are hinged to facilitate transportation. Folding is accomplished by movement of the hammer within the leads.

This pile driver was built in the Grand Trunk bridge shops. It is equipped with six reversible engines—one pair for raising the pile and hammer, one pair for swinging and one pair for movement of the driver on the main line. The engines are independent of one another, so that the pile or hammer

In its folded position, driver is ready for transportation without dismantling.

may be raised and the driver swung and moved ahead or back, all at the same time.

Mounted on Turntable

The driver is mounted on a centre turntable near the centre of a steel flat car. The boiler and reversible hoisting engines and cabin balance the leads and steam hammer, so that the driver may be swung at right angles to the track. A bent of piles 20 feet ahead of the front truck wheel of the car may also be driven.

This information was supplied by Mr. H. R. Safford, chief engineer of the Grand Trunk Railway System.

Electric Vehicles Profitable for Street Cleaning

THE Institute of Cleansing Superintendents recently held their annual conference at Nottingham, and one of the most important discussions was that dealing with the use of electrically-operated vehicles in the collection of refuse. A very practical paper on this subject was presented by Mr. J. Priestly, cleansing superintendent of Sheffield, from which the following is a brief extract:

The "electric" as a type of motor vehicle is particularly suitable for refuse collection, owing to its special features, which eliminated many of the disadvantages possessed by other types of motor vehicles for this work. A few features of the "electric" which particularly fit it for cleansing work are: (a) Motive power is ready to hand, particularly in those departments possessing a destructor; (b) economy of motive power whilst standing; (c) ease of starting; (d) noiselessness; (e) fewness of working parts; and (f) ease with which an unskilled man can learn to handle it. With petrol prices and restrictions so much in evidence, and coal and coke so difficult to obtain, (a) requires no elaboration. In work which is made up of stoppages every few yards for loading, (b) and (c) are self-evident advantages; (d) is of considerable importance where night work is carried out; whilst (e) and (f) require no argument with any cleansing superintendent who looks upon the havoc war has played with his staff. It was for these and other reasons that, in 1914, the author recommended his council to consider the question of using electric vehicles in the cleansing department, and an Edison battery vehicle of two tons capacity was delivered and commenced work in September, 1915, and has been at work continuously ever since. A few weeks' trial of this vehicle proved so satisfactory that a second was ordered and delivered in January, 1916, a third in May, 1916, a fourth in November, 1916, and a fifth in December, 1916. Five further vehicles were then ordered, and three of these are now at work.

The working costs of the "electrics" include (1) wages; (2) vehicle costs; (3) tires; and (4) electricity. The first item is the actual amount paid during the period under review. The second includes (a) interest and depreciation based on ten years' life; (b) insurance; (c) garage, watering, cleaning, and charging; (d) waste, oil, grease, etc.; and (e) repairs and renewals. The third is the actual cost under a maintenance contract, and the fourth is the amount charged against the vehicles for the current supplied from the destructors, and represents an interdepartmental profit. The details of the vehicle costs are:

	£	s.	d.
(a) Interest and depreciation—10 years' life....	123	5	10
(b) Insurance	8	10	0
(c) Garage, cleaning, charging, and watering...	25	2	8
(d) Waste, oil, grease, etc.	6	10	0
(e) Repairs and renewals	43	2	0
	£206	10	6

or £3 19s. 6d. per week, divided equally between day and night work. The basis of ten years' life may be challenged as too optimistic, especially by those familiar only with the life of petrol wagons, but the estimate is fully justified, for the following reasons:

Ten Years' Life Justified

1. One-half of the cost of the vehicle is represented by the battery, and this is guaranteed to give 100 per cent. of its original efficiency after eight years' constant service, and any defects not due to misuse are made good by the makers during such period.

2. The electric vehicle cannot be compared with steam or petrol vehicles, as there are less working parts. There are no boilers, cylinders, valves, cranks, pistons, clutches, or gears, all of which are liable to quick wear. The life of a vehicle with less parts to wear must necessarily be longer.

3. The electric drive subjects the vehicle to very much less strain and shock in starting or speed-changing.

4. The provision for repairs and renewals represents about 10 per cent. on the cost of chassis, less battery and tires, and allows, therefore, for complete renewal of the entire machine, less these items, in the ten years' period.

5. Although the vehicles are used for both day and night service, the total mileage per week is very low, and nearly one-half of this mileage is run without load. On this basis, therefore, ten years' life does not represent hard service.

During the period 20th March, 1916, to 25th March, 1917, during which five "electrics" were in service for periods varying from one year to three months, 51,498 tons 15 cwt. 1 qr. of bin refuse were collected by horses, at a cost of 5s. 5.4d. per ton, and 7,040 tons 11 cwt. by "electrics," at a cost of 4s. 9.8d. per ton. Of ashpit refuse 27,877 tons 12 cwt. were collected by horses, at a cost of 3s. 8.5d. per ton, and 10,670 tons 3 cwt. 3 qr. by "electrics," at a cost of 2s. 2.3d. per ton.

£2,000 Saving in One Year

The result of twelve months' working of electric vehicles in Sheffield is eminently satisfactory. Five vehicles have been at work for varying periods amounting in the aggregate to the work of practically 3½ vehicles for one year. The saving by them as compared with horse costs over the whole city amounts to £1,050 12s. 6d.; capital has been written off to the amount of £292 12s. 6d.; and electricity supplied from the destructors represents a further sum of £191 14s. 8d., making a total of £1,534 19s. 8d. Thus 3½ vehicles working for one year have cleared off more than the entire initial cost of 1½ vehicles. This result, be it noted, is in comparison with horse costs for the whole city, which does not represent the full facts. If the comparison was made only with horse costs for the districts now served by the "electrics," the saving shown would be materially increased and the total figure would be well over £2,000.

C.S.C.E. Represented at Irrigation Meeting

The Canadian Society of Civil Engineers was represented at the eleventh annual convention of the Western Canada Irrigation Association, at Maple Creek, Sask., August 1, 2, and 3, by R. J. Burley, F. H. Peters, S. G. Porter, C. M. Arnold, and M. H. French. The Calgary branch was represented by William Pearce and J. S. Tempest.

La Loutre Dam Half Completed

The St. Maurice Construction Company have now completed about 50 per cent. of the concrete work on La Loutre Dam, on the St. Maurice River, P.Q. The river portion of the concrete work is above high-water level, and about 10,000 yards of concrete are being poured each month.

Proposed New Highway

A 1,700-mile concrete military highway, from the Canadian to the Mexican border, through Montana, Wyoming, Colorado, and New Mexico, has just been proposed to the Federal Government of the United States by the Rocky Mountain National Military Highway Association, which was organized in Denver recently.

Mainly Constructional

East and West—From Coast to Coast

It is stated that another large paper and pulp mill is to be established at Grand Falls, Nfld., the machinery for the plant being forwarded from St. John, N.B.

The Kitchener Manufacturers' Association has inaugurated a movement for the development of the harbor at Port Dover in order to secure a shorter route for the haulage of coal to Western Ontario cities and towns.

Up till June 1 there were 70 new buildings in course of construction in New Glasgow, N.S., to the value of about $300,000. Permits for 35 new buildings have been granted snce. These 35 new buildings, with the 70 going up before, make a total of over 100 buildings now in course of erection.

Complaints are being made regarding the condition of the Dundas Street bridges between Lansdowne Avenue and Sorauren Avenue, Toronto. It is stated that the street is so narrow at this point that traffic is being diverted along College, also that the approaches are in a very bad state. Members of the City Council are taking up the matter, with a view to having improvements made.

At a joint meeting of the councils of King and Whitchurch townships, it was unanimously decided to go ahead with the work of constructing a subway on Yonge Street at Aurora. A road will be made 20 ft. wide, with sidewalks 6 ft. wide, and the subway will be 16 ft. high. The Dominion Railway Board will be asked to apportion the cost. Plans will be drawn immediately by Engineer E. A. James, but the work will not be proceeded with until the question of cost has been decided.

At a meeting of the Works Committee recently in Toronto, Works Commissioner Harris stated that it would be impossible to complete the work on the Bloor Street viaduct this year. He said it would not be safe to hurry the contractors in any way, and that he would assume no responsibility for any change in the present arrangements. The contractors have until December 24 to finish their part of the work. The paving of the bridge, however, is to be done by the city, and the works commissioner is opposed to making any start on this work until the completed structure has been handed over by the contractors. The steel work has just recently been finished.

As a result of recent complaints regarding pavement foundations in London, Ont., tests have been carried out on samples taken from the concrete foundation laid on Richmond Street. The pressures to which these were subjected, however, showed the concrete to be of good quality. In pounds per square inch the pressures resisted were as follows: 2,910, 2,306, 2,444, 2,715, 2,360, 2,390. The average is thus shown to be 2,520 pounds per square inch. The Wellington Street pavement made even a better showing under test, the pressure being 2,770 pounds per square inch. Mr. A. Marshall, of the Faculty of Applied Science and Engineering, University of Toronto, directed the tests and reported to the Board of Control.

The embargo placed by the G.T.R. on shipments of stone is causing concern among the officials of the Toronto-Hamilton Highway Commission as work on the highway will be held up if the situation is not relieved. Since July rapid progress has been made on the portion of the highway approaching Long Branch. The rate figured is about 80 yards per day, and if the commission can secure the stone, the stretch of roadway from the Humber River to Long Branch may be completed by the middle of October. West of this village a new section of the highway, for a distance of over half a mile, has just recently been opened for traffic. The work this year is being reinforced with Kahn road mesh, placed two inches below the surface. In Mimico and New Toronto, where water and sewer lines have been recently installed, both top and bottom of the road will be reinforced, on account of the increased width of the slabs. The total width of the present highway from fence line to fence line from Church Street, Mimico, to the Humber, is as narrow as 38 feet in parts and the whole highway is being widened to 66 feet, of which 24 feet will be paved.

Personals

Mr. Robt. W. Thomson, B.A.Sc., M.E., has been appointed district engineer by the B. C. Provincial Government, with headquarters at Kamloops.

Brigadier H. C. Hanton, of the Royal Engineers, has been gazetted chief engineer, attached to headquarters, with the rank of major-general. General Hanton is a veteran of the Northwest Rebellion and Central and South African campaigns, and has been mentioned in despatches early in the present war.

Mr. F. F. Longley, who formerly had charge of construction of the slow sand filtration plant at Toronto, Ont., has been granted a commission as major in the U. S. army and has been sent to France to assume entire charge of water supply for the American expeditionary force. Mr. Longley is a member of the firm of Hazen & Whipple, consulting engineers, New York City.

Mr. J. E. McAllister, C.E., of Toronto, has been appointed vice-president and general manager of the National Steel Car Company, Limited, Hamilton. Mr. McAllister is consulting engineer to the British-America Nickel Corporation and was formerly general manager of the British Columbia Copper Company. He is a graduate of the Faculty of Applied Science and Engineering of the University of Toronto.

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Principal Contents

Page

Co-ordinate All Departments

THIS is an age of efficiency—we are told. But if one were to analyze our modern life and mode of living thoroughly, from start to finish, one might find the idea more or less an illusion. That is the broad side of the question, however, which we may relegate to the philosopher; we must deal with the matter more specifically, and at least it is not too much to say, perhaps, that this is an age when efficiency is preached by many and practised by a few. It has indeed become a watchword in the world of business and its principles are gradually being accepted by those who have come face to face with the keen commercial competition which exists today, as the surest means to success. Nevertheless, it is generally easier to preach than to practise, and it is certainly a much simpler matter to preach efficiency than to put it in operation. We believe the experience of our readers will bear us out in this statement; most will agree that to inaugurate a movement for efficiency in one's own work and organization and to thoroughly imbue a staff with its principles, is no easy undertaking.

Efficiency is preached by many, and no doubt many of our readers have tired of the constant sounding of this one note. It is like the word "co-operation"—nearly worked to death. Doubtless many have installed "efficient" devices and systems with but little success, and have discarded them with more or less disgust, deciding that after all the old methods are the best. In such cases, "efficiency" comes in for much deprecation on their part; they decide that it is merely a fad and want nothing more to do with it or its exponents.

Just here, there are two facts which we do well to remember. The first is that the difficult part of efficiency is its inauguration, and the second is that, until efficiency has been applied to every part of the organization, a business cannot be said to be running efficiently. The truth of the first is fairly obvious. It takes courage and perseverance to set about the overturning of old methods and the introduction of new ones—especially in a large organization. There is the conservatism of workmen to be overcome and the process of training them in the new way of working. Probably old machinery and buildings may have to be scrapped and a considerable amount of money invested in new plant. Besides, there is an infinity of details which must be worked out before work can be commenced on a really efficient basis. However, once the organization has been perfected and the operations are being carried out in the "new way," difficulties gradually disappear and the business is soon running in the smooth and efficient manner which means greater savings and bigger profits.

In the second place, to be effective, the principles of efficiency must be applied to every portion of a business organization. Here, no doubt, is a rock on which a great many firms split. They invest money in "efficiency" schemes and devices for one department, while they neglect its principles completely in another. The result often is that their money is wasted. They stop a small leak and overlook a large one which is draining away their profits. Besides, the very basis of efficiency lies in the co-ordination of departments and the harmonizing of methods. For example, the effectiveness of an efficient field organization may be completely spoiled by haphazard office methods, and vice versa. If the office staff is blundering along in the dark, guessing at costs, and ignorant of conditions in the field and of the progress of work under way, the efforts of the men on the job will be of little avail in preventing financial difficulty or disaster. On the other hand, if the men in the field are wasteful and incapable, the efficiency of the office staff will go for nothing; they may detect the waste, but they cannot pull the job out of the hole.

This, we believe, is the secret of the success of the biggest contracting and engineering organizations in the country—a thorough co-ordination of the efforts of all their departments, or in other words, team work. Efficiency is not, as some people imagine, a kind of charm worked out by the adoption of little systems and devices; it is a method of working in which waste of time, of movement and of material is eliminated as far as possible, and the logical result is greater profits with less effort.

New Type of Chimney for C.P. Railway Yards

Monnoyer System of Reinforced Concrete—Minute Description of Construction Methods — The Sixth of its Kind in America

THE Canadian Pacific Railway Company have recently had constructed in their West Toronto yards a new type of chimney which has been used extensively in Europe, but is comparatively unknown on this continent. To be exact, there are but six examples in America, four of these are in Eastern Canada, one at Nobel, Ont., and the other in Toronto. It is known as the Monnoyer System of Reinforced Concrete Chimney, and is similar, in the larger aspects, to other designs in that it consists of a foundation, a base and a shaft.

The foundation and base are designed in the same manner as for column footings, differing only in that the earth pressure must be determined with reference to the effect of wind pressure and vertical loads combined. These present no new engineering features. The foundation is a solid reinforced concrete slab, 1½ ft. in thickness, while the base consists of an octagonal retaining wall, also of reinforced concrete, having an earth fill (well tamped with a liberal use of water) in the centre and covered by a 6-inch concrete floor. This is clearly shown by Fig. 2. The vertical reinforcing rods in the sub-foundation are carried up into the superstructure and tied into the vertical reinforcing of the shaft. It is the shaft itself wherein the unique construction of this system occurs. It is made up of blocks 10 ins. in height, carried up in courses, the number of blocks in the course varying in accordance with the diameter of the chimney. Each block is formed with a hook on one end, Fig. 3, which is set over the corresponding block immediately below it and overlaps the adjacent block forming a corner of the chimney. It is in these corners that the vertical reinforcing rods are placed, being continuous to the top.


Fig. 1 C.P.R. chimney.

The blocks are constructed in adjustable metal forms, Fig. 4, consisting of three parts. These were assembled on the floor of a neighboring workshop or on smooth boards near the site of the chimney. They are so constructed that blocks of any thickness and length can be made without altering the forms. Parts A and B are held in position with bolts, and C, placed at a distance the required thickness of the blocks from B, is clamped in position. Wooden blocks are then placed as shown in diagram. After the forms are assembled a layer of 1:2 mixture is pressed against the face of the form with the hands, and concrete, consisting of a mixture of 1:2:3 in a semi-dry state is shovelled in and tamped well. Two ⅝-inch rods are placed in each block to enable them to be transported and placed with impunity. A half-inch layer is scraped off the top of the block and a layer of 1:2 mixture substituted. A groove a half inch deep and one inch wide is then made along the top to provide for the half-inch horizontal reinforcing rods that are placed along the top of each course. The forms are removed immediately upon the completion of a block, which is allowed to stand for a day or two. They are then piled in rows and sprinkled with water for a period of a week or more to become sufficiently set before using. Some blocks are constructed with hooks on the left and others with hooks on the right, Fig. 5. This is due to the blocks in each course having the hooks on the reverse end to the blocks in the preceding row.

Special blocks of the design shown in Fig. 6 are placed at intervals throughout the chimney, adding to the artistic appearance. These blocks are constructed with cells, to facilitate handling, which are afterwards filled with concrete when the blocks have been placed in position. They are wider than the general blocks.

After the foundation and base is sufficiently set work is started on the stack. The blocks are laid in courses, the square end of one block is set into the hook of the adjoining block, Fig. 1, and the open space caused by the hook is filled with concrete. After the course is completed a half-inch reinforcing rod is placed in the grooves along the top of the blocks. This is tied to the vertical reinforcing at each corner. A half-inch layer of mortar (1:2 mixture) is then spread along the top of the blocks and the next course is placed.

The hooks are placed immediately over those of the preceding course and are on the reverse end of the blocks. Three or four courses can generally be placed from the ground and then a scaffold is erected on the inside of the chimney from which the blocks are hoisted by means of an engine placed at an opening in the foundation, the smoke tunnel, a cleaning out door or a hole left for the purpose, being utilized. The blocks are then carried through the opening and attached to the cable. By this method blocks and concrete are hoisted from the inside until the chimney is completed.

These chimneys are lined with fire brick set in fire clay generally carried up one-third of the height of the chimney and self supporting.

A sectional steel ladder is built up on the inside along with the construction of the chimney, having its supports tied into the vertical reinforcing of the chimney proper. These rods are placed between every second course. The top is surmounted by a cast iron cap into which the lightning rod is set.

The chimney erected for the Canadian Pacific Railway was 135 ft. in height with inside diameter at the summit of 5 ft. 6 ins., and at the base 11 ft. 2 ins. The foundations were carried down to a depth of 5 ft. 6 ins. below the ground level and consisted of a concrete slab and a concrete retaining wall of gravity section (see Fig. 2). The foundation was an octagonal shaped slab of concrete (1:2:4 mixture) one foot six inches thick and reinforced in both directions with one inch square rods spaced ten inches centre to centre. The

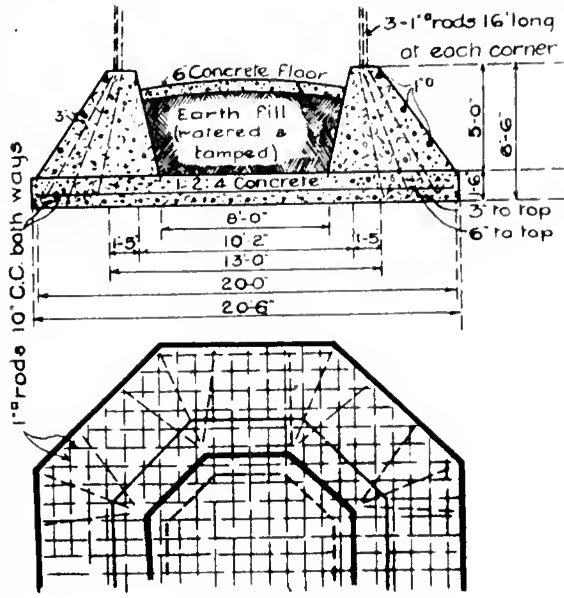


Fig. 2—Details of foundations.

first set of rods was placed three inches from the bottom and the second set three inches above the first.

The sub-foundation was an octagonal retaining wall 6 ft. in width at the base, 1 ft. 5 ins. at the top and 5 ft. in height. This was reinforced horizontally with three sets of 1-inch rods spaced as shown in Fig. 2, and overlapping at the joints for a length of four feet. It is also reinforced vertically with three one-inch rods at each corner. These are tied at the bottom into the horizontal reinforcing in the foundation, and converging at the octagonal corners at the top of the wall are carried up and tied into the vertical reinforcing of the stack. The concrete, mixed in a

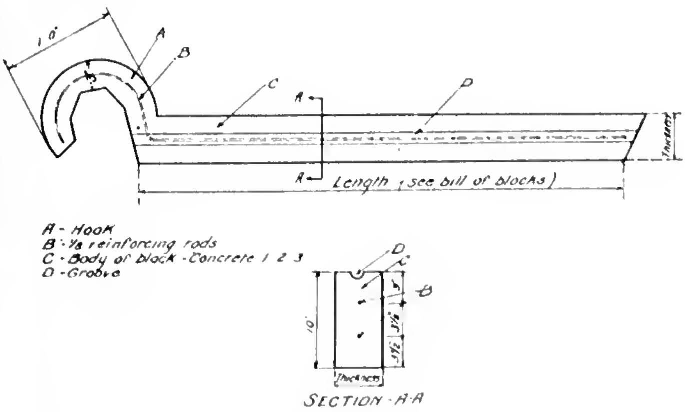


Fig. 3—Concrete block.

gasoline mixer mounted on a platform, flowed into the forms with the aid of troughs. The reinforcing was held in place by means of wood framing.

During the construction of the foundation other men were engaged making blocks, so that by the time the forms were removed from the foundation sufficient blocks were on hand to keep the erection continuous. For this process of block making three masons and three assistants were employed. Two of the assistants were kept busy mixing concrete, which was carried by the third assistant to boards within reach of the block makers. The operation of making 1,136 general blocks occupied a period of 19 days or an ap-

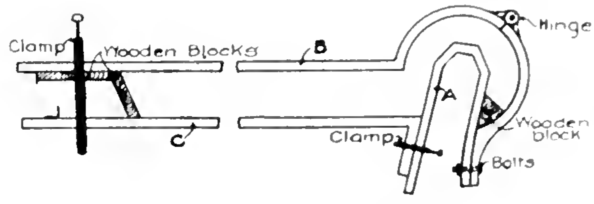


Fig. 4—Adjustable metal forms for blocks.

proximate average of 60 blocks daily. It is hardly necessary to mention that the forms were cleaned after the completion of each block. The size and number of blocks required are shown by the following table:—

Bill of Blocks

Thickness	Length	Quantity Left	Right
5 in.	4 ft. 3 in.	40	32
5 in.	4 ft. 1 in.	32	32
5 in.	3 ft. 11 in.	40	40
4½ in.	3 ft. 9 in.	40	40
4½ in.	3 ft. 7 in.	40	40
4½ in.	3 ft. 5½ in.	40	40
4 in.	3 ft. 4 in.	40	40
4 in.	3 ft. 2 in.	40	40
4 in.	3 ft. 0 in.	40	40
4 in.	2 ft. 10½ in.	40	40
4 in.	2 ft. 8 in.	40	40
4 in.	2 ft. 6½ in.	40	40
4 in.	2 ft 4 in.	32	24
4 in.	2 ft 3 in.	40	40
4 in.	2 ft 1 in.	32	32
Totals		576	560
Special Blocks			80
Total Blocks			1,216

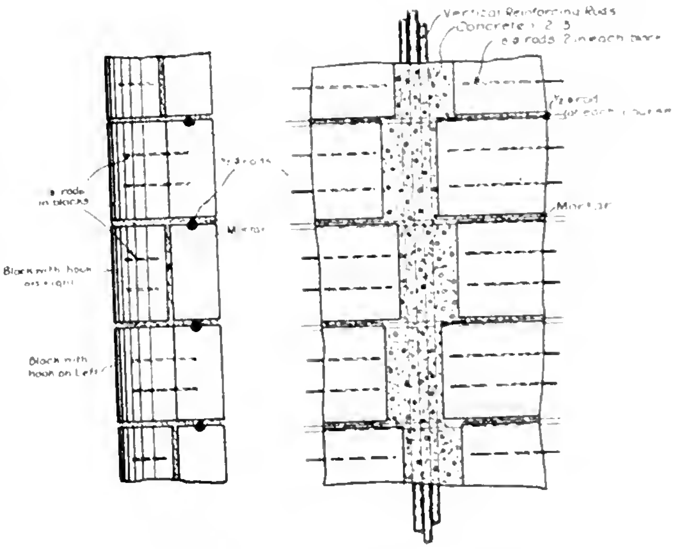


Fig. 5—Alternate courses. Elevation at interior corner.

In making the special blocks more time is required on account of the increase in size. Blocks in the courses designated by T, R, and S are of design shown in Fig. 6, while the blocks in courses O, P, N and M are smaller and are solid reinforced concrete. The following table shows dimension and number of special blocks:—

Block	Thickness	Length L-1	Length L-2	Quantity
T	13 in.	5 ft. 2½ in.	4 ft. 8½ in.	8
R	13 in.	5 ft. 2½ in.	4 ft. 3½ in.	16
S	13 in.	5 ft. 3½ in.	4 ft. 4½ in.	8
O (Solid)	12 in.	3 ft. 5½ in.	2 ft. 7½ in.	16
P "	14 in.	3 ft. 11 in.	2 ft. 9 in.	8
M "	12 in.	3 ft. 7 in.	2 ft. 2 in.	16
N "	14 in.	3 ft. 9 in.	2 ft. 6 in.	8
Total				80

There were three different groups of these blocks at intervals throughout the chimney, each group con-

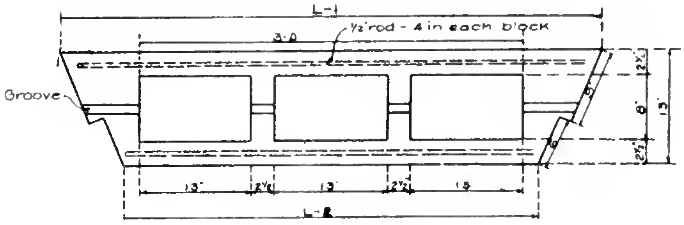


Fig. 6—Special blocks.

sisting of three courses. Fig. 8 shows blocks and reinforcing required.

When the forms were removed from the foundation there were sufficient blocks on hand to keep the erection continuous. Two masons and five assistants were employed on this work and in a ten-hour day laid 80 blocks, or ten courses. An opening was left 2 ft. above the boilers in the adjacent boiler room for the smoke flue. This flue was constructed of steel plates 3/16 in. in thickness and 4 ft. wide by 6½ ft. inside. The chimney was lined with four inches of fire brick set in fire clay to a height of 45 ft., leaving a two-inch air chamber between the lining and the stack. The summit was fitted with a cast iron cap (Section at centre shown by Fig. 9) into which a lightning rod

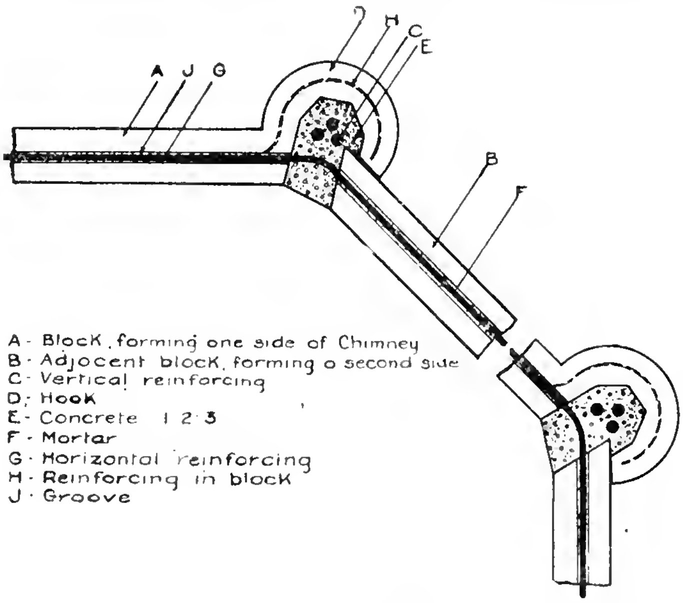


Fig. 7—Adjacent blocks set together.

was fitted. The lightning rod itself consisted of 30 pure copper wires, interlaced and arranged so that each wire is capable of doing its independent share of the work. This rod is fastened to the chimney with holdfasts and terminates in an earth terminal plate of copper three feet square and 1/16 in. thick buried three feet in the ground. The lightning rod is also equipped at the summit with eight gilded copper points, 1

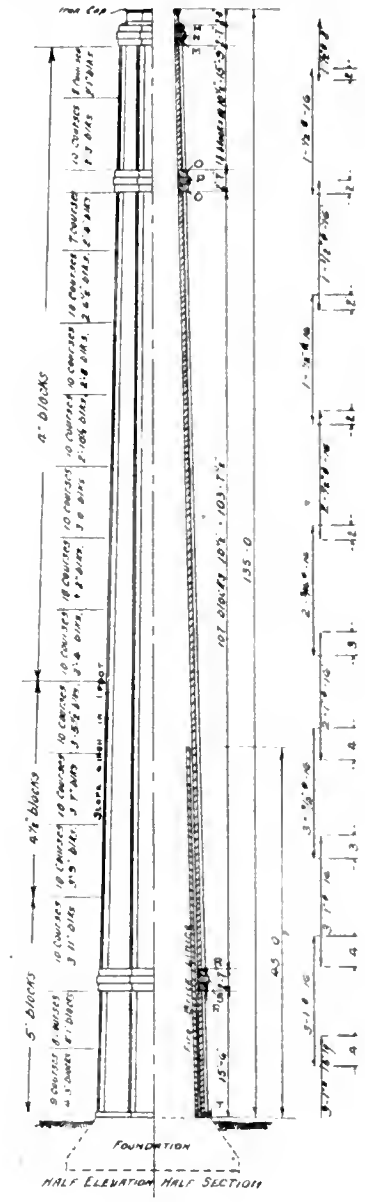


Fig. 8—Half elevation, half section.

foot long. This chimney it designed to withstand a wind pressure of 100 miles per hour.

The completed chimney is shown in Fig. 1.

The advantages of this type of chimney are many. No delay is caused in the construction, for when the

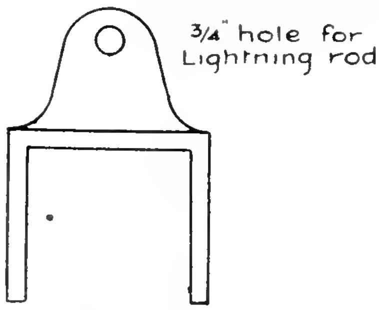


Fig. 9—Section cast iron cap.

weather is too bad to permit work on the chimney the men can make blocks in a covered shed. The architectural appearance, which has, until recent years, been lacking in chimney design, is second to none. Many manufacturers are beginning to realize that the appearance of their factories and surroundings create quite an impression on the mind of the consumer.

This chimney cost in the neighborhood of $3,200 and can be erected in nine or ten weeks.

With regard to stability, the question has been asked, "Is the reinforcing sufficient." The amount of reinforcing is naturally small as the load is purely vertical and of the same amount. Take for instance an ordinary reinforced concrete chimney. Specifications call for half-inch reinforcement spaced from 1 to 1½ feet apart, while in the Monnoyer type, in addition to the vertical reinforcing we have ½-in. rods around the top of each course, as well as the reinforcing in the blocks.

The firm of Edward Pelletier and Sons, of Quebec, were the contractors, which firm have the rights for this system in Canada and the United States. Dodd & Struthers, of Sherbrooke, supplied the lightning rod.

Modern Uses of Cement Gun are Legion

Repointing Joints in Sea-wall—Much Greater Penetration than with Hand Work — A Work of Permanence

THE uses to which a cement gun may be put are now almost legion, but nothing demonstrates the value of this equipment better, possibly, than the results obtained during the present summer in the re-pointing of about 22,000 lineal feet of joints in the west side of the sea wall at Governor's Island, New York. This work is described by Mr. H. W. Babcock in the July-August Professional Memoirs, from which the following description is taken:—

The sea-wall is built of heavy stones laid in courses; none of the courses were required to be of uniform height throughout except the coping, which was 1 ft. high and 3 ft. wide. The joints were ordinarily 1 to 1½ in. thick, sometimes reaching 2 ins. On the northwest, or Hudson River, side of the wall the mortar had come out of the joints, almost generally, indicating that the joints had not been made full, but voids had been left in which ice formed. Frequently the joints were found open to a depth of 2 ft. or more.

The Cement Gun Company furnished the cement gun at $250 a month; the air compressor at $5 a day; an operator for the gun at $6 a day, and an engineman to run the compressor at $4 a day. The United States furnished 5 to 7 laborers, a horse and cart and an overseer. The lease with the Cement Gun Company also provided for payment to them of transportation charges on the plant and for 4 days' time allowed for transportation. The transportation charges were $216, being about trebled for the requirement of delivery on the island.

Work was begun at the north end of the extension sea-wall near Castle William on June 1, 1916, and was stopped June 29, 1916, at a point of 4,170 ft. from the beginning. The linear feet of joints pointed was about 22,320, averaging 900 ft. to the working day. At the beginning, the rate was much slower on account of inexperience and bad weather, although the location was near the sand pile and the cement storage. The rate also varied on account of tides, more work being accomplished when low tides occurred near the middle of the day.

In filling the joint, the operator turned on water only until the joint was washed clean, then the mixture of cement and sand with the water, sweeping over any convenient length of 4 to 8 ft. at a time. The mortar filled the joint gradually in from 2 to 5 minutes, depending largely on the voids as well as on the length covered. When the joint was nearly full, the visible completion appeared sudden.

The operator stood on the riprap foundation of the wall during work until the tide rose too high for rubber boots, when a plank swing was hung over the wall for a platform; this was for about 33 per cent. of the time.

Tide Water Washed Mortar Out

Some difficulty was met with in the lower joints, which are under water at high tide. They could be filled only at low tide, and the swash of waves or swells from passing steamers would often wash out the mortar for a depth of 3 to 6 inches, a result which would happen from any pointing. Covering these joints with a weighted canvas screen was tried, but it was not effectual. Towards the close of the work, a few linear feet of joint were covered with plaster of Paris, ⅛ to ¼-in. thick. This set at once and stayed on for a day, when the cement had hardened. It was rather slow and expensive for general use.

It was at first intended to mix the cement and sand at 1 to 2. The Cement Gun men said that their experience led them to believe that the force with which the mortar was driven caused some of the sand to rebound, and that 1 to 3 was a better proportion. This was adopted. In these closed joints, however, the loss of sand from this cause was small. It is estimated that between 10 and 15 per cent. of the mortar was wasted from spattering and overfilling the joints, and that this contained practically the same proportion of sand as the original mixture.

Had to Heat the Sand

To drive the cement and sand through the hose with compressed air, it is essential that the mixture be quite dry. In the early part of June there was much damp, foggy weather, and the sand got damp and, although the cement was kept quite dry, the mixture clogged in the hose. It is very probable that the compressed air was also fully saturated. The trouble was overcome by heating the sand on an iron plate over a fire of drift wood.

The filled joints were probed with an iron bar at several points to see whether the mortar penetrated the full depth of the joint. It appeared to do so. A test was made by building a box 3 ft. long (the maximum depth of joint), 18 ins. wide and 1 in. high, with one end, 18 ins. by 1 in., open. This was laid flat on the wall and mortar driven into it with the gun, as in ordinary work. The box was covered with canvas and sand, and after three days it was opened. The mortar had filled the entire box, with exception of a small pocket of dry sand on each side about half way in, and another very small one at each back corner. The slab of mortar was cracked through in two places, during handling. The bottom of the slab was homogeneous and smooth, with impression of the grain of the wood. The top was uniform only for the outer 12 inches; farther back it had several depressions of 1/8 in. or less, looking as if water had stood there, separating from a too wet mixture, and had dried away. The character of the mortar was not uniform. For 12 ins. from the open front it was compact and good; back of this it became more porous with more frequent grains of coarse sand.

A very crude breaking test of sections of the slab was made when it was 16 days old (July 14), by standing in the middle of the sections; the sections were of different widths, according as the slab broke, each being a beam 18 ins. long, 12 ins. between supports, and 1 in. thick..

	Width on which pressure was applied In.	Width of beam In.	Approximate breaking load Total Lb.	Per sq. in. Lb.
Section from inner end of slab	4	8	100	12½
Section from middle of slab	4	10	150	15
Section from outer end of slab	4	12	250	21

This is altogether too inaccurate for a test of the class of mortar; it gives a fair idea of the relative strength in different parts of the slab.

Best Method of Filling Joints

None of the mortar in the slab was really first class; it might be called fair. It filled the joints to an extent which could not be done otherwise:

Expenditures:		
Rental of cement gun	$250.00	
Rental of compressor	125.00	
Services of operator	150.00	
Services of compressor engineman	100.00	
Transportation, including 4 days' rental time	216.00	
		$841.00
Rental, 2 tarpaulins to cover cement		41.85
Services:		
Manisees and Ingalls and crew, freighting supplies and general assistance	$171.58	
U. S. inspector and overseer, with 5 to 7 men	641.09	
2 horses, carts, and drivers, 34 days	136.00	
1 double team and driver, 1 day	8.00	
		956.67
Materials:		
800 bags cement	$324.00	
125 28/100 cu. yd. sand	91.71	
635 gallons gasoline	152.40	
Force pump, fittings, and hose for water	81.66	
Lumber, runways and mortar beds	59.76	
Tools: Wheelbarrows, shovels, sand screen, etc.	34.60	
Rope, for moving machines	24.09	
Miscellaneous: Canvas, rubber boots, etc.	39.48	
		807.70
Office expenses and travel	$258.93	
Photographs	7.45	
		266.38
Total		$2,913.60

This cost will be reduced by a rebate on cement bags returned in good condition; not yet determined, but probably about $60.

The value of materials and tools not used up on the work is estimated at $262.70. This will not far exceed the cost of removing them and storing them until needed, and must be regarded as part of the cost of work in a locality such as Governors Island.

The length of joints repointed, 22,320 feet, was measured, and is essentially correct. The open widths varied from 2½ in. to nothing, and the depths repointed from 36 ins. to 3 ins. These can not be averaged with any accuracy, being almost wholly out of sight. It is roughly estimated that the average thickness of joint is slightly less than 1 inch, and the average depth perhaps 12 to 15 inches.

Penetrated Farther than Hand Work

The cost of this work with the cement gun was not far from the cost of the same lengths of joint repointed by hand. Hand work would give a better finish, but would hardly extend more than 4 inches into the wall.

The cost at Governors Island is 10 to 15 per cent. more than it would be at an accessible point in this city.

In operating the cement gun, a large supply of compressed air is needed. It is used to turn the cement and sand feed as well as to carry the dry mixture. This mixture will choke in the hose unless diluted with a large amount of air. From such observations as could be made, it appeared that the volume of sand and cement carried was from 1 to 2 per cent. the volume of the air used as a vehicle.

The amount of water required was given by the Cement Gun Company as 5 gals. per minute, at pressure of about 45 lbs. This quantity was seldom used, and the stated pressure is not needed. The suction from the air blast would draw in the water if delivered at the nozzle under a much lower head.

At Governors Island, fresh water could not be had along the line of the sea-wall; and salt water from the bay was used, pumped up through a fine brass mesh.

No Deterioration Shown

An examination was made Oct. 9, 1916, and another May 17, 1917. In neither case was there found any deterioration since the repointing was done. For about half the length of wall repointed, the lower joints, at and below half tide, are from 2 to 3 inches slack; and for a length of 125 ft., near the lighthouse, the lower joint is from 10 to 15 in. slack. This 125 ft. was repointed June 22, 1916, when the sea from a strong northwest wind washed the mortar out while it was fresh.

On May 17, test drills were driven 6 inches into the joints at these places; the mortar was everywhere firm and very hard. With hand pointing, the joints would not be filled to a depth of 6 inches.

The Time to Develop Trade

Since the outbreak of the war, applications have been received at the Department of Commercial Intelligence of Great Britain from a large number of firms in all parts of the United Kingdom, and abroad, who wish to get into communication with British manufacturers or producers of various classes of goods which have previously been obtained from Germany and Austria-Hungary. Applications have been recently received for the names of manufacturers or producers of the following articles. British manufacturers or producers of these articles now in a position to supply are invited to make application for the names of the enquirers:—Carbon electrodes; diamond dies for wire drawing; drawing pins; boilers designed for using peat as fuel; gas generators designed for peat; machinery for excavating and generally handling peat; maize oil; paper, nature casings; school chalks; tin, brass and copper linings and angle plates for ammunition boxes.

Creosoted Wood Stave Pipe and Its Effect Upon Water for Domestic and Irrigation Uses

THOUGH untreated Douglas fir wood stave pipe normally has a very long life when properly installed, the use of untreated pipe in irrigation lines where the pipe is periodically empty is not conducive to long service, for the conditions for decay may often under such circumstances be at an optimum. As wood stave pipe has the undeniably great advantage of low initial cost, ease of installation and proportionally greater carrying capacity than other usual forms of pipe it is used very extensively, but lately a demand for some method of protecting the pipe from decay under the severe conditions encountered in irrigation service has arisen. Experiments have therefore been made by private companies to determine the effect of creosoting upon the quality of the water passing through wood stave pipe. It is generally recognized that properly creosoted material remains immune from decay for considerable periods of time, and as the experiments mentioned above indicated that creosoting did not import an offensive taste to the water, it has been asserted that creosoted wood stave pipe lines can be used with highly superior results.

Experiments to Determine Effect of Creosote

In the spring of 1916, the city of Seattle was urged to use creosoted wood staves in the reconstruction of the main water supply lines of its water system. As no really authoritative experiments had been made to determine the practicability of such use, an appeal was made to the Bureau of Industrial Research of the University of Washington to take up the problem and to determine by a series of tests just what effect the creosoting of wood stave pipe under such conditions would have upon the potability of the water passing through the pipe. With the co-operation of the parties most directly concerned with the problem the experiments described in the following report were accordingly carried out. The taste of the water was accepted as evidence of its potability, as the slight amount of creosote would not be sufficient in quantity to produce the slightest physiological effect on the users of such water.

The test was extended to determine the effect of minute quantities of creosote upon the availability of the water in irrigation.

Method of Testing

The apparatus used in this experiment consisted of 48 feet of four-inch creosoted Douglas fir wood stave pipe, treated as described below, a round Douglas fir stave tank 3 feet in diameter and 9 feet deep, 2½-inch rotary circulating pump, electrically driven, and various galvanized iron connecting pipes, valves and other minor fittings. The staves for the pipe were treated on September 16, 1916, in the experimental plant of the Pacific Creosoting Company at Creosote, Washington. The material used in the experimental pipe consisted of twenty-five dressed staves of the following description: Length, 10 feet; number, 25; lineal feet, 250; cubic feet, 5.45; weight, 203 pounds.

In the same charge with these staves were included 12.5 cubic feet of undressed stave lumber. This was included as the Bureau intended to conduct a test on pipe manufactured from material treated "in the rough" and dressed after treatment, in addition to that manufactured from the staves which were dressed before treatment. The use of the pipe manufactured from this material was, however, found to be impracticable.

After treatment the dressed staves were found to weigh 292 pounds, indicating a treatment of 16 pounds of creosote per cubic foot of wood. The rough staves, which were not used in the subsequent experiments, were found to weigh 608 pounds, indicating a treatment of 7½ pounds of creosote per cubic foot of wood.

Conduction of Experiment

The equipment and operation of this experiment was such as to make it representative as nearly as possible of conditions existing in a 56-inch creosoted wood stave pipe line carrying water from Landsberg intake, on Cedar River, to the Volunteer Park reservoir in the city of Seattle. Since the length of such a pipe line would be approximately 22½ miles, or 118,600 feet, water flowing at a velocity of 5 feet per second would be in contact with the inner surface of the pipe for approximately six hours. In this experiment water was therefore circulated through the pipe for six hours at a velocity of 5 feet per second before taking each sample and renewing the volume of water in the pipe.

As the ratio of the inner area to the volume is fourteen times as great in a 4-inch pipe as in a 56-inch pipe of equal length, a tank containing a volume of water equal to fourteen times the capacity of the pipe was connected to the intake and discharge ends of the pipe. Since the inner surface of this tank had no action on the water contained in it, the ratio of the total inner surface of the creosoted wood stave pipe used in the experiment to the total volume of water circulated through it was the same as the ratio between the total inner surface of a 56-inch pipe line 22½ miles long and the total volume of water in such a pipe line. Therefore, since the ratio between the creosoted surface and the quantity of water was the same, the velocity of the flowing water was the same and the water was in contact with the creosoted surface for the same length of time, conditions in this experiment were considered to be thoroughly representative of those existing in a 56-inch creosoted wood stave pipe line conveying water from the Landsberg intake on Cedar River to the Volunteer Park reservoir in the city of Seattle.

Pipe Lay-out

The 48 feet of creosoted wood stave pipe was laid in the form of a letter U in the bottom of a concrete canal about 4 feet deep and 4 feet wide. The intake end of the pipe was fitted into the side of the tank about 4 inches from the bottom. The circulating pump drew water from the other end of the pipe through a short section of galvanized iron pipe, and discharged it below the surface of the water in the storage tank through another section of galvanized iron pipe. The depth of water in the tank was kept at 8 feet and 3 inches so that the volume of water in the tank remained equal to fourteen times that in the pipe. The head of water in the centre of the pipe was therefore 7 feet 9 inches, sufficient to overcome any tendency for a negative head to occur in the pipe or pump.

The velocity of the water in the wood pipe, as computed from the time necessary to discharge the entire tank full of water, was 4.6 feet per second. Very little variation in velocity during the test could take place, as the motor maintained a constant speed and the pump was of the constant displacement type. The top of the storage tank was tightly boarded over and covered with roofing paper. An air-tight joint was made between the staves and the cover before nailing the latter down. Every precaution was taken to avoid any possible aerating effect through the discharge of the water into the tank or during its period of standing in the tank.

Pipe Submerged in Water

The wood pipe was partly or entirely submerged in water during the entire test. During the last days of the test the pipe was completely covered by water. The system was emptied by uncoupling the discharge pipe from the pump and pumping the water out of the tank and pipe. During the first two weeks of the test the temperature of the water in which the pipe was partially immersed was very near the freezing point. Later the temperature rose somewhat, probably averaging 40 degs. Fahr.

The tank was filled with water and allowed to soak for eight days before it was connected with the pipe, to rid the tank of the woody taste that new tanks impart to water. However, in some of the first samples taken during the test, a decided woody taste was noticed. The test began on November 12 and ran continuously except for two twenty-hour periods until it was completed on December 13. During the first nine days of the test the tank and pipe were emptied three times a day: at 6 a.m., 12 m. and 6 p.m. During the following eleven days they were emptied at 12 m. and 6 p.m. only. During the last nine days of the test the volume of water in the pipe and tank was changed only at 12 m., with two exceptions, when samples were desired. It is apparent, therefore, that one volume of water was circulated through the system for twelve, eighteen and sometimes twenty-four hours instead of six hours as it should theoretically have been. However, as this water was not used in the samples tested and as the amount of creosote absorbed by the water in any case was infinitely small, this fact was not considered as having any appreciable bearing upon the accuracy of the test. Any possible error worked to the disadvantage of the pipe under test.

Samples were taken at the end of each six hour run. Two liter glass bottles with ground-in glass stoppers were used. The samples were stored in a cool place until they were tested.

Results of Tests

The Bureau staff met five times during the progress of the experiment and tested various samples of the water. The results are as follows:

Sample taken after the pipe had been in continuous service for 7 days: Noticeable taste of both creosote and wood was detected.

Sample taken after 13 days: Undiluted sample had a slight taste of creosote, while no appreciable taste was noticeable in sample diluted with two gals. of tap water.

Sample taken after 19 days: Six persons of the eight present at the test could detect no trace of creosote.

Sample taken after 26 days: Two members of the staff could detect no foreign taste, while two noticed a slight taste.

Sample taken after 29 days: Presence of foreign matter was not detected in undiluted condition, diluted, or in tea. There seemed to be practically no difference in a sample taken after pipe has been in service 29 days and a sample taken from ordinary city water.

Creosoted Pipe for Irrigation Projects

Although the main problem in this investigation was to determine what effect creosoted wood stave pipe lines would have upon drinking water, the Bureau Staff felt that it would be wise to determine what effect small amounts of creosote in the water would have upon crop plants if used for irrigation. The experiments on this phase of the problem may be arranged under three different headings: 1. The effect upon growing plants. 2. The effect upon the germination of seeds. 3. The effect upon plants grown in water cultures.

The water used in the following experiments was obtained from an experimental pipe line other than the one used in the experiments previously described in this report. A short description of this pipe line therefore follows:

The staves used in this pipe were thoroughly kiln dried before treatment. They were treated by the Pacific Creosoting Company with a commercial charge of lumber. Due to the fact that the staves were so much drier than the lumber, they absorbed an undue portion of the creosote oil. The staves were accurately weighed immediately before treatment and again after the charge was withdrawn, and they were also carefully measured to determine their exact volume. From this data the absorption of the oil was determined to be 24 pounds per cubic foot, far in excess of the treatment desired.

The pipe was laid on the surface of the ground, exposed to the sun's heat every day until about noon. As the test was conducted during the summer, the temperature of the pipe and the water contained in it was very high. The pipe was filled with water, which was allowed to remain in a stagnant condition for six hourse, when a sample was taken and the pipe emptied.

Effects on Germination

The effect of the test water on growing plants was determined by experiments with numerous seeds watered every day with the test water. At the end of three months no difference could be distinguished between the plants watered with the test water and those watered with tap water, either as to time of germination, percentage of germination, rapidity of growth or general vigor of the plants.

No difference could be detected in the percentage of seeds germinating when either tap water or water from the creosoted pipe line was used.

Special culture media were used to promote growth. Samples of these media were diluted with both the creosoted pipe water and tap water. Seedlings were treated with these media and the comparisons made daily. No difference could be detected between them.

General Conclusions

1. As previously stated, conditions in this experiment are considered to be thoroughly representative

of those existing in a 56-inch creosoted wood stave pipe line conveying water from the Landsberg intake on Cedar River to the Volunteer Park receiving reservoir in the city of Seattle.

2. After the experimental pipe line had been in service for thirteen days, no taste of creosote could be detected in a sample of the water diluted with two parts of ordinary city water.

3. After the experimental pipe line had been in service upon twenty-nine days, no taste of creosote could be detected in undiluted water flowing through it.

4. The amount of creosote that diffuses into water in ordinary creosoted pipes does not have an appreciable injurious effect upon plants either in the time of germination, the percentage of germination, the rapidity of growth or the general vigor of the plant.

Further Reports on Montreal Aqueduct

Majority Report Favors Scheme Number Two, but Mr. McRae Still Urges Acceptance of Private Contract

A FURTHER report of the Montreal Aqueduct-Power Development scheme has been made by the board, consisting of Messrs. A. G. Vautelet, A. St. Laurent and J. B. McRae—the original committee—this time to consider particularly the tender of the Civic Investment & Industrial Co. for the supply of electric power. The Board was unable to agree, the two first mentioned being of the opinion that Scheme No. 2, as originally outlined in the Contract Record, viz., for a maximum power development representing 24,500 h.p. in summer, 13,000 h.p. in winter and a $10,609,000 expenditure, would be more advantageous to the city than the purchase of power from the private company. Mr. McRae dissented from this view. The report of the Board is as follows:—

Montreal, August 18th, 1917.

Gentlemen,—

According to instructions from the Board of Commissioners, our Board met in consultation with Dr. Herdt to consider the tender of the Civic Investment & Industrial Co. for the supply of electric power to the city, and our Board also considered the offer of the Cook Construction Company either to do any work connected with the aqueduct project at cost plus 15 per cent., or to abandon their contract waiving their right to anticipated profits.

Our Board is unanimous in recommending that the contract with the Cook Construction Company be cancelled as per the terms of their letter of July 17th, 1917, and that their offer to do the work at cost plus 15 per cent. be rejected.

Our Board in consultation with Dr. Herdt calculated that, according to the new specifications and tender of the Civic Investment Company, the cost of purchased power for pumping an average of 100,000,000 imperial gallons per day would be $235,585 per year.

From a letter of A. B. Cook, dated July 17th, 1917, it was ascertained that the said Cook Company were willing to waive their rights to anticipated profits. The cost of work to be done if hydraulic development be abandoned was, therefore, diminished by $279,575. On the other hand, since December 31st, 1916, work has been done and undertaken for an amount of $185,-225. The total cost of buying current was, therefore, diminished by $94,350, and the interest thereon by $4,718. The total cost per year for the operation of the pump house at Atwater Avenue and of the filtration plant for an average consumption of 100,000,000 imperial gallons was, therefore, reduced from $656,000 to $606,991, and the cost on h.p. basis from $62.47 to $57.81.

We would call your attention to the letter of the Civic Investment & Industrial Company, accompanying their tender, and more especially to clauses "d" and "g."

Clause "d" might be interpreted as meaning that a minimum of 8,000 h.p. must be used at Atwater Avenue and the wording of the beginning of the clause re minimum payment is not clear.

Clause "g" may be interpreted as meaning that to the prices mentioned in the tender must be added the taxes: Municipal, Provincial and Federal other than existing municipal taxes. This should be made clear and the proportion of said taxes, if any, chargeable to the city should be determined in advance.

It remained for the Board to decide whether it would recommend to the city to accept the tender of the Civic Investment Company, or to go ahead with the hydraulic development as per Scheme No. II.

After discussion it was found impossible for the members of the Board to agree and it was, therefore, resolved to make two different reports on the final recommendations to be made in addition to the recommendations and findings of the report of April 30th, 1917.

(Signed) H. E. Vautelet, Chairman.
A. St. Laurent.
J. B. McRae.

The Majority Report

Gentlemen:—

Remarks on the tender of the Civic Investment & Industrial Company.

The calculations of the cost have been made on existing data for the monthly peak load for periods of 2½ and 3 hours. As the specifications call for payment on maximum monthly peak load for a period of 20 minutes, the sum to be paid may be larger than calculated.

The indefinite amount of taxes to be paid in addition to the contract prices may also make an appreciable difference.

We are also of opinion that the provision made for heating the filtration plant is inadequate and will further increase the cost of buying electric current.

As the average monthly peak load calculated is 1.16 of the average consumption, it follows that the minimum price paid by the city for power actually used will be 1.16 x 26.50 = $30.74 per e.h.p., and the total cost per h.p. will be $57.81.

It must be remarked, however, that the annual amount of $235,585 will have to be paid only when the water consumption of the city reaches 100,000,000 imperial gallons per day, and that until that time the power bills will be smaller, but after that time gradually increase with the increased consumption of water.

The abandonment of the hydraulic development will necessitate a capital expenditure of $1,500,000, the greater part of which need not be immediately made.

It will also necessitate the immediate capital expenditure of $373,000 for the construction of the electric pump house.

Remarks on Scheme No. II.

If it is decided to go on with the hydraulic development as per Scheme No. II., it will not be necessary to prosecute the work immediately and it will be better to wait until the cost of labor and material has become normal again.

In the meantime, the city can continue to pump the water by steam.

It is, however, necessary to insure the supply of water in case of an accident to the conduit. This has been provided for to a certain extent by the emergency supply from the Lachine Canal, but that supply can only be resorted to for a short period.

To insure it more completely, it will be necessary to be able to draw the water from the aqueduct canal and, therefore, to build a dam at the site of the old power house, so that the canal may be filled up in case of need.

We think the best way to do this would be to put in the foundations of the power house at a cost of $400,000, and to proceed with the rest of the work as circumstances will allow.

The cost on h.p. basis as mentioned in our previous report will be $56.90 when the average consumption of water is 100,000,000 imperial gallons per day, but until such time it will not be necessary to have all the works completed and the annual expenditure will be less.

It must be remarked, however, that when that average consumption becomes larger than 100,000,000 imperial gallons per day, the cost on h.p. basis will diminish to $50.35 as mentioned in our previous report, and that the city will have an additional power of 11,500 h.p. at a cost of $5.06 per h.p., or $6.74 per e.h.p. during seven summer months.

From the previous remarks we conclude:

(1) The cost on h.p. basis for the buying of current ($57.81) is larger than in the case of Scheme II. ($56.90).

(2) When the consumption of the water by the city is larger than 100,000,000 imperial gallons per day (probably in ten years), the cost on h.p. basis for buying current will remain the same ($57.81), whereas in the case of Scheme No. II. it will diminish ($50.35).

(3) During seven months of summer Scheme No. II. will give the city 11,500 additional h.p. at a cost per e.h.p. of $6.74 per annum, whereas it would have to pay $15.46 for that same power to the contractor.

(4) In the case of purchased power, the boulevard scheme as proposed has to be abandoned. Though we cannot attach a tangible value to the boulevards, they certainly will be a benefit to the city.

(5) The immediate capital expenditure necessary in both cases will be about the same.

We Therefore Recommend:

That the city proceed with the hydraulic development of the Aqueduct as per Scheme No. II.;

That the foundation of the power house be built as early as possible to insure the water supply of the city;

That the balance of the work be proceeded with as circumstances will allow.

(Signed) H. E. Vautelet,
A. St. Laurent.

Mr. J. B. McRae, the consulting engineer who differed from his two associates on the latest aqueduct report, has forwarded to the Controllers the following letter of explanation:

"As stated in our Board's letter to you of the 18th inst., we have not been able to agree on a recommendation regarding the aqueduct schemes.

"The estimates show that the cost of operation is in favor of buying power, under the terms of the tender made by the Civic Investment and Industrial Company. The figures for pumping at a rate of 100,000,000 imperial gallons per day being:

Cost of operation, Scheme II.	$740,000
Cost of buying power	606,991
Difference in favor of buying power	$133,009

"This saving is per annum, and assuming present conditions of operation. Modern machinery and proper operation will reduce the cost of power considerably. Your attention is also drawn to the fact that it will be some years before the city requires the 100,000,000 imperial gallons per day. In the meantime you pay for the power used to meet your requirements which is much less proportionately for bought power than any of the power development schemes.

Favors Bought Power

"I am informed that certain improvements are to be made at the Reservoir and in the piping system. These improvements are for the purpose of cutting down the quantity of water pumped and reducing the friction head, against which the pumps are working. These improvements will favorably affect all the schemes, but it should be particularly noted that the reduction in cost of operation is greater in the case of bought power than in any of the other schemes.

The figures for the cost of operation have been used here for comparison and not the cost per horse power. The horse power basis should not be used, as it does not give a true comparison when comparing bought power with the other scheme.

"I would recommend that you enter into a contract with the Civic Investment and Industrial Company, for a quantity of power to meet your present requirements. The Aqueduct should be put in such shape as will safely bring a supply of water for domestic and fire purposes, to the pump house. Provision should also be made for the future development of such hydraulic power as may be developed economically. Such power, in combination with that purchased, will make the most economic power supply now possible, and should be sufficient for the city's requirements for at least the time of the power contract."

Horses in Trousers

When the horses in Nice, France, are hitched to tar spreading carts they wear trousers to protect their legs from the hot tar. A further protection for them consists of a curtain suspended between the cart and the horse. The trousers are what lend distinction to the horse, however. The knees are a bit baggy, but the horse doesn't seem to care.—Popular Science Monthly.

Working Stresses in Reinforced Concrete

Recommendations of Joint Committee of Engineering Societies

(Concluded)

WORKING STRESSES

1. General Assumptions

The following working stresses are recommended for static loads. Proper allowances for vibration and impact are to be added to live loads where necessary to produce an equivalent static load before applying the unit stresses in proportioning parts.

In selecting the permissible working stress on concrete, the designer should be guided by the working stresses usually allowed for other materials of construction, so that all structures of the same class composed of different materials may have approximately the same degree of safety.

The following recommendations as to allowable stresses are given in the form of percentages of the ultimate strength of the particular concrete which is to be used; this ultimate strength is that developed at an age of 28 days, in cylinders 8 in. in diameter and 16 in. long, of the consistency described in our issue of July 25, page 645, section 2 (d), made and stored under laboratory conditions. In the absence of definite knowledge in advance of construction as to just what strength may be expected, the committee submits the following values as those which should be obtained with materials and workmanship in accordance with the recommendations of this report.

Although occasional tests may show higher results than those here given, the committee recommends that these values should be the maximum used in design.

Table of Compressive Strengths of Different Mixtures of Concrete (in Pounds Per Square Inch).

Aggregate.	1:3*	1:4½*	1:6*	1:7½*	1:9*
Granite, trap rock	3300	2800	2200	1800	1400
Gravel, hard limestone, and hard sandstone	3000	2500	2000	1600	1300
Soft limestone and sandstone	2200	1800	1500	1200	1000
Cinders	800	700	600	500	400

*Combined volume fine and coarse aggregates measured separately.

2. Bearing

When compression is applied to a surface of concrete of at least twice the loaded area, a stress of 35 per cent. of the compressive strength may be allowed in the area actually under load.

3. Axial Compression

For concentric compression on a plain concrete pier, the length of which does not exceed 4 diameters, or on a column reinforced with longitudinal bars only, the length of which does not exceed 12 diameters, 22.5 per cent. of the compressive strength may be allowed.

For other forms of columns the stresses obtained from the ratios given in our issue of August 15, page 700, section 9, may govern.

4. Compression in Extreme Fibre

The extreme fibre stress of a beam, calculated on the assumption of a constant modulus of elasticity for concrete under working stresses may be allowed to reach 32.5 per cent. of the compressive strength. Adjacent to the support of continuous beams stresses 15 per cent. higher may be used.

5. Shear and Diagonal Tension

In calculations on beams in which the maximum shearing stress in a section is used as the means of measuring the resistance to diagonal tension stress, the following allowable values for the maximum vertical shearing stress in concrete are recommended:

(a) For beams with horizontal bars only and without web reinforcement, 2 per cent. of the compressive strength.

(b) For beams with web reinforcement consisting of vertical stirrups looped about the longitudinal reinforcing bars in the tension side of the beam and spaced horizontally not more than one-half the depth of the beam; or for beams in which longitudinal bars are bent up at an angle of not more than 45 degrees or less than 20 degrees with the axis of the beam, and the points of bending are spaced horizontally not more than three-quarters of the depth of the beam apart, not to exceed 4½ per cent. of the compressive strength.

(c) For a combination of bent bars and vertical stirrups looped about the reinforcing bars in the tension side of the beam and spaced horizontally not more than one-half of the depth of the beam, 5 per cent. of the compressive strength.

(d) For beams with web reinforcement (either vertical or inclined) securely attached to the longitudinal bars in the tension side of the beam in such a way as to prevent slipping of bar past the stirrup, and spaced horizontally not more than one-half of the depth of the beam in case of vertical stirrups and not more than three-fourths of the depth of the beam in the case of inclined members, either with longitudinal bars bent up or not, 6 per cent. of the compressive strength.

The web reinforcement, in case any is used, should be proportioned by using two-thirds of the external vertical shear in the following formula (vertical web reinforcement): $T = \frac{Vs}{jd}$, where T=total stress in single reinforcing member; V=total shear producing stress in reinforcement; s=horizontal spacing of reinforcing members; jd=arm of resisting couple. The effect of longitudinal bars bent up at an angle of from 20 to 45 degrees with the axis of the beam may be taken at sections of the beam in which the bent up bars contribute to diagonal tension resistance as defined in Contract Record, August 15, page 699, as reducing the shearing stresses to be otherwise provided for. The amount of reduction of the shearing stress by means of bent up bars will depend upon their capacity, but in no case should be taken as greater than 4½ per cent. of the compressive strength of the concrete over the effective cross-section of the beam. The limit of tensile stress in the bent up portion of the bar calculated by Formula $T = \frac{3}{4}\frac{Vs}{jd}$, using in this formula an amount of total shear corresponding to the reduction in shearing stress assumed for the bent up bars, may be taken as specified for the working stress of steel, but in the calculations the stress in the bar due to its part as longitudinal reinforcement of the beam should be considered. The stresses in stirrups and inclined members when combined with bent up bars are to be determined by finding the amount of the total shear which may be allowed by reason of the bent up bars, and subtracting this shear from the total external vertical shear. Two-thirds of the remainder will be the shear to be carried by the stirrups, using the formulae given above.

Where punching shear occurs, provided the diagonal tension requirements are met, a shearing stress of 6 per cent. of the compressive strength may be allowed.

6. Bond

The bond stress between concrete and plain reinforcing bars may be assumed at 4 per cent. of the compressive strength, or 2 per cent. in the case of drawn wire. In the best types of deformed bar the bond stress may be increased, but not to exceed 5 per cent. of the compressive strength of the concrete.

7. Reinforcement

The tensile or compressive stress in steel should not exceed 16,000 pounds per square inch.

In structural steel members the working stresses adopted by the American Railway Engineering Association are recommended.

8. Modulus of Elasticity

The value of the modulus of elasticity of concrete has a wide range, depending on the materials used, the age, the range of stresses between which it is considered, as well as other conditions. It is recommended that in computations for the position of the neutral axis, and for the resisting moment of beams and for compression of concrete in columns, it be assumed as:

(a) One-fortieth that of steel, when the strength of the concrete is taken as not more than 800 pounds per square inch.

(b) One-fifteenth that of steel, when the strength of the concrete is taken as greater than 800 pounds per square inch and less than 2,200 pounds per square inch.

(c) One-twelfth that of steel, when the strength of the concrete is taken as greater than 2,200 pounds per square inch and less than 2,900 pounds per square inch, and

(d) One-tenth that of steel, when the strength of the concrete is taken as greater than 2,900 pounds per square inch.

Although not rigorously accurate, these assumptions will give safe results. For the deflection of beams which are free to move longitudinally at the supports, in using formulas for deflection which do not take into account the tensile strength developed in the concrete, a modulus of one-eighth of that of steel is recommended.

560 Foot Steel Arch Over Niagara River

The Engineering News-Record is authority for the statement that a steel arch of about 560-ft. span is to take the place of the Niagara cantilever bridge of the Michigan Central R.R. at Niagara Falls, N.Y. The cantilever bridge is famous as being the first of its type in this country, having been built in 1883-84 to the designs of the late C. C. Schneider. Each of the two cantilevers is 395 ft. long, with 195-ft. anchor arm, 175-ft. river arm and 25-ft. tower span. The suspended span is 120 ft., making a total length of 910 ft. The height is 240 ft. from the water to rail level. The two lines of trusses are 28 ft. centre to centre, and the deck carries a double track.

The cantilever bridge was strengthened in 1900 in order to adapt it to the greatly increased loading. This remarkable piece of bridgework consisted in building a third truss on the centre line of the structure, supported on new columns in the towers. Further strengthening to meet the requirements of the still heavier loadings of the present day is not practicable, and the famous bridge, which has already given 33 years of active service, is to be replaced by a new bridge of a different type.

The new steel arch bridge will have a clear span of about 560 feet, with a rise of about 132 feet from the hinges to the bottom chord, while the truss depth at the crown will be about 30 feet. The bridge will carry three tracks. The present steel-arch railway bridge at Niagara Falls, built in 1896-97, has a span of 550 ft., with a rise of 114 ft. from springing line to bottom chord, or 134 ft. to the deck.

No time has been set for the construction of the new bridge. Under present conditions definite action will probably be postponed, but the plans are in preparation. This work is in charge of H. Ibsen, special bridge engineer, who has a separate staff independent of the bridge department. The work is under the direction of J. F. Deimling, acting chief engineer of the Michigan Central R.R. during the absence of George W. Webb (now a colonel in the army).

Extension to Negropoint Breakwater

Bids are being asked by the Federal Government for an extension of Negropoint Breakwater, at the harbor of St. John, N.B., and for the repair of the existing breakwater. The extension is to be constructed of random stone, is 1,490 feet long, and will extend from the lighthouse to Partridge Island. The work consists of a rubble mound 25 feet wide at the crest and 32 feet above low water, spring tide. The core of the breakwater will be of stone, weighing one to five tons, deposited to a depth of 16 feet above low water and with slopes of three horizontal to one vertical on the weather side and 1½ to 1 vertical on the harbor side. The stone covering the core for a distance of 16 feet on both sides and on the top will be blocks of five to twelve tons and over. The repair work involves the placing of sufficient random stone between the lighthouse and the outer end of the concrete superstructure on the existing breakwater, to bring that portion of the breakwater to a width of 25 feet at the crest of an elevation of 32 feet above low water, spring tide. For this work, a length of 500 feet, blocks of from five to twelve tons and over will be used.

Imperial Mineral Resources Bureau

By direction of the War Cabinet in Great Britain, Dr. Addison, the Minister of Munitions, has made arrangements for the appointment of an inter-departmental committee to prepare a scheme for the establishment in London of an imperial mineral resources bureau. Its objects will be to collect information in regard to the mineral resources and metal requirements of the Empire, and to advise what action, if any, may appear desirable to enable such resources to be developed and made available to meet requirements. Sir James Stevenson is chairman, and the secretary is Mr. Oswald C. Allen, to whom communications on the subject should be addressed at the Ministry of Munitions, Whitehall Place, London.

New Warehouse for the Canadian General Electric Co.

The new warehouse in course of erection for the Canadian General Electric Company on their property in King Street West, adjacent to the head office building, has been designed to meet the requirements of the company with regard to proper and efficient storage and warehouse accommodation for its large and varied interests.

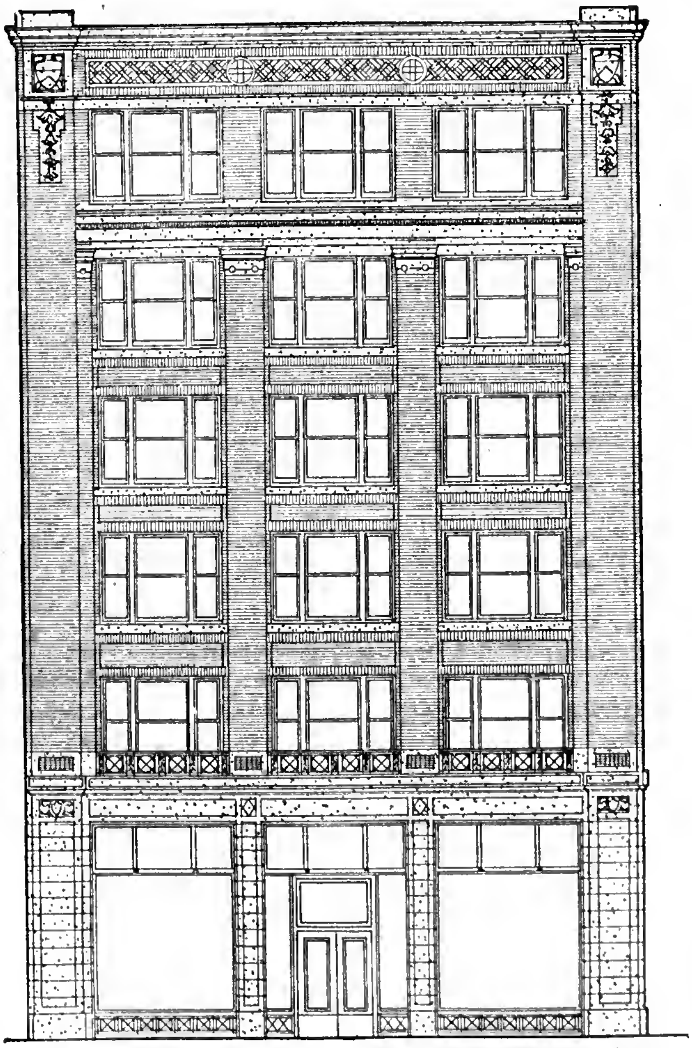
The building is of mill construction, six storeys high, exclusive of basement, and with a frontage of 47 ft. 3 in. and a depth of 185 ft. 4 in. The ground floor contains the sales department and packing and shipping rooms; all other floors are used for storage purposes. The building is equipped with steel spiral goods chute, automatic dumb waiter, electric freight elevator, and the fire risk is covered by modern sprinkler equipment. The main entrance on King Street is through a spacious vestibule flanked by large show windows, and opens direct into the sales department.

The King Street front and the south pavilion on the east elevation to the height of second-floor window sills is built in grey limestone, with a tooled face. Above this point both the King and Pearl Street fronts are faced with tapestry brick, of a buff-grey color, with grey limestone trimmings.

The floors are of solid plank construction, and, with the exception of the ground floor, each floor is designed to carry a live load of 200 pounds to the square foot. All framing timbers—viz., girders, beams, and columns—are of solid British Columbia fir.

The requirements of large, unobstructed floor spaces, well lighted, have been the keynotes of the plan which is expressed in the pier and pilaster treatment of the street fronts and east side elevation, forming large window areas.

In keeping with the policy of the Canadian General Electric Company, this building has been designed by Canadian architects, and is being erected by Canadian contractors, and, generally speaking, the materials throughout are of Canadian manufacture.



Burke, Horwood & White, Architects.
New Warehouse for Canadian General Electric Co.

Concrete Lumber

THE recent past has seen the introduction of the fireproof type of construction and its wide adaptation to large structures, such as office buildings, factories, and hotels. Its progress has been very rapid, and now still further developments along this line are becoming apparent. A writer in "Expert American Industries" speaks of the manufacture of "concrete lumber"—that is, concrete made up and sized like ordinary lumber and formed into joists, flooring, stairs, including strings, treads, rises, and handrail, chair and picture rails, window boards and framing, and, indeed, interior trimming of most kinds where woodwork is generally used. The writer states that this innovation enables the construction of a fireproof house at a cost only a little more than 30 per cent. greater than for one of a quick-burning type. Such a house, as described, has a frame of steel, and all walls, partitions, ceilings, floors, and roof of steel and concrete. Over the concrete roof is placed a waterproofing, elastic and pliable, so that expansion and contraction have no undue effect upon it. The partitions are of concrete, 2 in. thick, and specially reinforced. Conduits, water pipes, etc., are as easily placed in the concrete as in hollow partitions. Another advantage is the fireproof stairway—a big factor of safety in case of fire. The interior trim can be of wood, fastened with screws, or metal trim can be used if desired. Comparative costs of this and other types of houses are given as follows: Fireproof house as described, 21 cents per cubic foot; house built with 12 in. solid brick walls, with same interior, 28 cents; built with stucco on hollow tile, with wood interior, 17 cents; built of stucco on metal lath, with wood interior, 16 cents.

Centering for the 170 ft. concrete arch span of the Myers Creek highway bridge, California, was supported on reinforced concrete sand-boxes 5 ft. square with a 12 in. by 12 in. chamber 12 in. deep filled with sand controlled by a 1-in. outlet pipe. The centers were lowered by removing about one part of sand from the sand-box in each of twelve successive operations. The arch settled about ¾ in. without cracking.

The deepest mine in the world is the Morro Velho in Brazil, the lowest galleries of which are 6,000 feet below the surface. The Morro Velho is a gold mine, worked by an English company. The gold-bearing vein descends into the earth like a great knife, at an angle of 45 degrees. The normal temperature at the bottom is only 113 degs. F., and by ventilation is kept down to about 100.

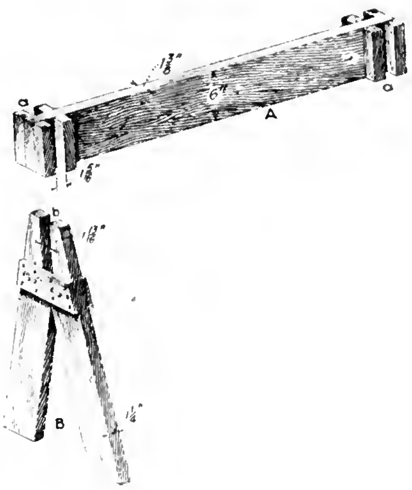
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Trestle Easy to Move and Store

By Ernest Schwartz*

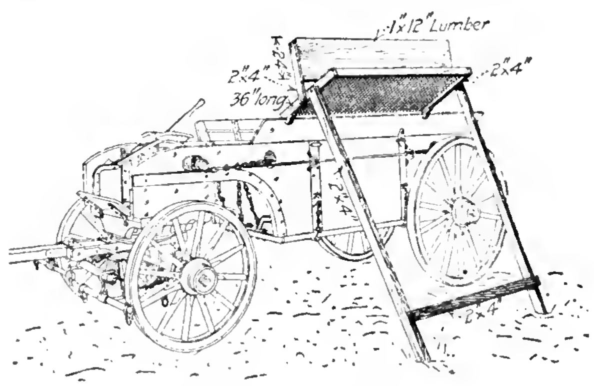
THE sketch shows a trestle which may be readily taken down and stored in small space and without danger of breakage. The top bar is provided with grooves at each end, formed by nailing strips of wood on each side to a bare clearance for



the upper ends of the legs. The legs are framed with a slot at the top, which is a close fit for the top bar. This trestle, which has been found useful in shop practice, might prove economical on building construction, as the ordinary trestle is certainly difficult to store, besides deteriorating rapidly as a result of handling from place to place.

Improved by Adding a Target

In our issue of August 1 we reproduced an item from Engineering News-Record showing how a screen placed on the side of a wagon is a handy scheme for



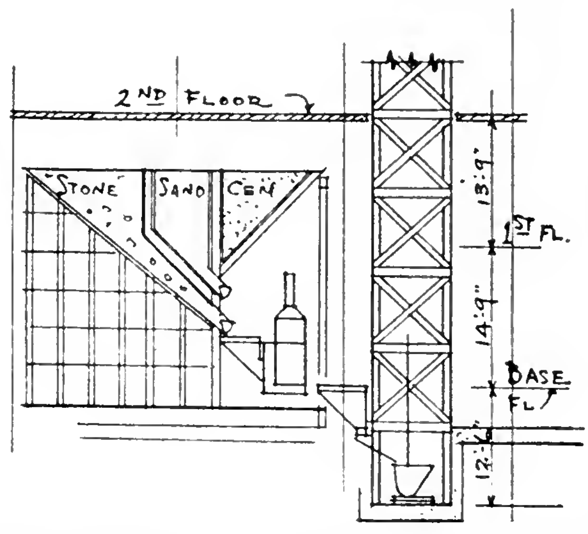
sifting the gravel and preventing rehandling. This scheme, however, was open to the objection that the gravel had to be thrown across the wagon onto the screen, thus very materially increasing the amount of labor required.

In a later issue Mr. F. M. Hough, superintendent of construction in the United States Reclamation Service at El Paso, Texas, suggests the addition of a target to the screen, as shown in the attached sketch. This does away with having to throw the material across the wagon, and so lightens the labor, at the same time enabling the material to be kept cleaner. Mr. Hough states that he has used this device with considerable saving in cost over screening on the ground. This device is easily adaptable to minor changes to suit varying conditions, and should be a useful appliance in almost any gravel pit.

Concrete Plant Designed for Fast Mixing and Placing Has Many Interesting Features

The concrete plant for the construction of Montgomery, Ward & Co.'s six-storey storage warehouse being built at Thirty-ninth and Robey Streets, Chicago, possesses some features of interest, described as follows in Cement World:

The mixing plant, equipped with two ¾-yard Milwaukee mixers, is located in the centre of the building. Here also are located stone, sand, and cement storage bins. Sand and stone cars enter the building on a level with the first floor and dump through the trestle, on



which they enter into a long hopper bottom storage bin. A conveyor belt on each side of the V-shaped bottom of the bin leads to the storage bins above the mixer, one for sand and one for stone. Cement is delivered in bags to a shed on the first floor, where two men empty sacks through a floor hopper into a conveyor belt, which in turn delivers to the cement storage bin.

The Milwaukee mixers empty into a common hopper with a capacity of three yards, which by means of a hopper bottom with a two-way spout feeds two one-

*In Engineering News-Record.

yard Lakewood hoist buckets operating independently. These can be filled simultaneously or one bucket can be filled while the other is traveling up or down. At the top of the tower the buckets dump into separate hoppers, emptying into a three-way chute, from which the two lines of spouting diverge.

The two lines of spouting extend east and west from the twin towers 125 feet in each direction and each line dumps into two floor hoppers placed back to back. This divides the floor into four equal units, and the distance from any point in one unit to the floor hopper situated in that unit is the same as from a corresponding point in another unit to its floor hopper.

The plant, when speeded up, mixed and placed over 1,000 cubic yards on some days, and a floor a week was the record made.

1,200-Ton Cargo Steamer for Great Lakes to Be Built of Reinforced Concrete

SHIPBUILDING facilities on the Great Lakes are about to be increased. Marine engineers and shipbuilders have recognized in the combination of concrete and steel a shipbuilding material of great durability, density, rigidity, and with sufficient elasticity to mark it for special favor. Steps are now being taken to begin the construction of reinforced concrete ships on the Great Lakes at the earliest possible date. The Torcrete Shipbuilding Company, recently organized at Chicago, is now negotiating for a suitable yard location near Detroit, where it is proposed to begin at once the building of a 1,200-ton cargo steamer for Great Lakes service. Additional yards near New York, New Orleans, and Los Angeles will be established later. All of these plants will build reinforced concrete vessels after what is known as the Torcrete system. The company has already prepared a number of designs for ships, lighters, and barges, which have received strong endorsement from those who have inspected the plans. These plans have also been submitted to the United States Government and to the United States Emergency Fleet Corporation, with a view to assisting in the rapid construction of a merchant marine.

Technically, Torcrete is a combination of steel and concrete, the practical application of which results in a laminated hull, inlaid with steel reinforcing. Torcrete is applied under air pressure after a new process and with a machine, both of which are inventions of Carl Weber, a well-known consulting engineer, who has for many years specialized in the various uses of concrete. Mr. Weber is president of the Torcrete Shipbuilding Company. By Mr. Weber's process the usual forms required for concrete work are practically done away with, while the most elaborate stream-line hulls are made easily possible and at much less cost than by any other known method of shipbuilding. Hull surfaces are perfectly smooth, so skin friction is reduced to a minimum. Such vessels cannot rust, burn, or leak, and the cost of maintenance and repairs is practically eliminated.

Another invention of Mr. Weber, in the speeding up of ship construction, is a unique launching method which eliminates the cost of expensive shipyard facilities and makes it possible to build concrete ships on short notice in almost any locality where such vessels are needed. A special feature of his launching method safeguards the concrete hull against underway stresses, therefore a vessel can be launched immediately after the submerged portion of the hull is completed without waiting for the usual thirty to sixty-day period for the complete hardening or curing of the concrete.

Immediate Possibilities in the Development of Electro-Chemical Industries

The important position already occupied by our electro-chemical industries is probably not sufficiently appreciated. Though comparatively in their infancy and of somewhat small dimensions, they include many of the basic requisites in the development of our larger industries, without which the latter would be quite impossible. Speaking before the Western Society of Engineers recently, Mr. F. A. Lidbury, manager of the Oldbury Electro-chemical Company, of Niagara Falls, outlined in more or less detail the more prominent of the electro-chemical industries, their relative importance, power requirements, and the reasons for their existence in certain localities. The speaker's remarks referred more particularly to the United States, but are almost equally applicable to Canada, and are specially interesting as denoting the trend and the extent of the development of these industries by our neighbors to the south. Mr. Lidbury's address was of considerable length, and only extracts are given below:

Electro-chemical industries, roughly speaking, can be divided in one way into three classes. First of all, the class which you could not turn out of this country if you tried to; second, the class that has grown up here in this country sometimes to as great an extent as is necessary, and sometimes not, and is still continuing to grow within certain limits. This second class of industries are those which depend upon favorable conditions, and to a great extent that means favorable power conditions, for their continued growth and existence in this country. The third class will be that group of industries which has not yet found a footing in the country; and we will also include in that class those industries which have not sprung into existence anywhere, but which the future will surely produce.

Copper Refining

Now, taking the first class, we will find that the first electro-chemical industry there and an extremely important one, as electrical engineers in particular know, is one that you could not get out of the country, whatever you did to it, and that is copper refining. I think that we can omit any discussion of this particular industry from our subject to-night without losing anything, because it does not bear on the general principles that I want to talk about. It is here because this is a great copper-producing country, and the question of power in copper refining and in certain other allied industries is of such a relatively small nature that it is entirely overshadowed by other conditions, principally transportation conditions and conditions regarding interest on the money that is tied up in the very expensive stuff one is handling and refining. So, though this is perhaps as important a single electro-chemical industry as there is, yet the electro-chemical portion, in so far as that relates to power supply, is a very minor factor.

The industries that have sprung up in the country in the last twenty-five years can be grouped again, roughly speaking, in accordance with their size as power consumers. One finds oneself in a somewhat difficult position discussing a lot of these questions at the present moment, because though a couple of years ago it would have been relatively easy to pick an electro-chemical product and show the requirements of the country in this particular product as equivalent to so many thousand kilowatts, one cannot do it to-day, because many of those industries have received considerable stimulation from the conditions now prevailing, perhaps not so much directly a war stimulation as a stimulation which has been due to the general increase in business. And it is a matter that I, for one, would not pretend to decide, how far that increase in demand, and in some cases of production, in these particular industries, should be regarded as something that is bound to show a drooping curve in the next few years. That circumstance will make it necessary for me to give you figures with very great reservation, and not attempt to get close to the actual mark; though, as I say, a couple of years ago one could have given them very much more closely and a good deal more definitely.

Big Power Demand of Aluminum Industry

We find that perhaps easily first of the single electro-chemical industries in point of power requirements, and also in point of value of product, is the aluminum industry. As far as one can make out, there are something like 130,000 kilowatts of capacity installed in this country at present for the purpose of making aluminum. Not all of it, however, is in operation, because of conditions, particularly at Niagara Falls, to which I will not refer just now. There are, as far as we can make out, about 60,000 additional kilowatts either being installed at present or contemplated, and this indicates the requirements of the aluminum industry alone in this country as somewhere between one hundred and two hundred thousand kilowatts. Now, no one, I think, can put a definite and arbitrary limit on the growth of that particular industry. The demands seem to be increasing every year. And those demands are not, to a very great extent, war demands, but the increased demand has also come about by the rapid extension of the general uses of aluminum, as, for instance, in the automobile. Its use in the automobile is not only direct, but indirect, and includes the manufacture of certain elements of alloys, which are constituents of the modern high-speed steels and of steels of a nature which enables small, light parts to be used in places demanding great strength in the automobile, where a few years ago a carbon steel of much greater dimensions had to be used.

The Ferro Alloys, Etc.

Next in line, and in point of size, we come to a group of compounds which cannot very easily be separated from one another—the ferro alloys, including ferro-silicon, ferro-chromium, ferro-molybdenum, and so on. It is a little difficult to put a figure to the power requirements of this class. I think somewhere about 100,000 kilowatts would come near the mark.

The next in size is probably calcium carbide, which may take 30,000 kilowatts or more. The calcium carbide industry is not growing to-day at the same rate as a few years ago. The use of calcium carbide for illumination is not so great. But, on the other hand, the use of acetylene for welding, and so on, is increasing, and is to-day, from an engineering point of view, by far the most important use of calcium carbide.

Artificial abrasives are the next in point of size, and I think some twenty to thirty thousand kilowatts—perhaps a higher figure would be nearer the mark—would represent the necessities of this country in the manufacture of fused alumina and silicon carbide, which constitute the basis of all modern grinder work.

Then we have the electrolytic alkali business, which gives us caustic soda or caustic potash, and chlorine in the form of bleaching powder, liquid chlorine, or other chlorine products, for which again perhaps 30,000 kilowatts would be a reasonable figure to take for the requirements of the country.

Then we come down to the manufacture of chlorates, which are used in the match industry, in the textiles, for the manufacture of oxygen, and in certain chemical operations. That might be put as consuming about 10,000 kilowatts. And, again, sodium, which, of course, is not much used in its original form, but from which is made sodium peroxide, used in the textile industries as a bleaching agent, and which is still more important as a starting point in the manufacture of sodium cyanide, will take up perhaps 15,000 kilowatts.

Then there are a number of minor articles, such as phosphorus, carbon bisulphide, and other products of the electric furnace or of electrolytic processes which might include one or two thousand kilowatts each. And, of course, if we wanted to go into the really small processes, there are numerous little units working all over the country on this, that, or the other special branch of electrolytic work which may take anywhere from a few kilowatts up to a few hundred.

From the consumptive point of view, then, I have given you the actual position at present of the industries that have grown up in this country in the last twenty-five years and now constitute, as I wish to point out to you very emphatically, the absolutely indispensable source of materials without which we to-day could not get along.

Indispensability of Electro-chemicals

I do not know how I am going to begin to give you any idea of their indispensability. Starting with aluminum, many of you know as much about its uses as I do. It has come into very large use in a considerable number of ways, and we would not like to get along without it. It forms, at any rate in combination with small amounts of other elements, alloys combining strength with extreme lightness. And those of you who have followed, for instance, the tendencies in automobile construction are aware of the extent to which the advances in the last few years in the ways of combination of lightness with power and performance have depended upon the use of this material. I have pointed out already the extent to which this material is used in the manufacture of high-grade steels which have become indispensable for mechanical operations, cutting, and so on, and also indispensable to structural purposes where extreme lightness and strength are necessary.

When we come to the ferro alloys, the same remark applies. And in the case of one of them—ferro-silicon—one gets a very good instance of how indispensable the products of the electro-chemical industry are. About 70 to 75 per cent. of all the steel that is made in this country to-day is made in the basic open-hearth furnace. And all of that steel, in its manufacture, requires the use of ferro-silicon. No ferro-silicon, no open-hearth steel. And with the conditions facing the steel manufacturers in these times, that means a very serious diminution, an extremely serious diminution in the steel output of the country, and on top of that, I think I could safely add, an extreme diminution in quality. In other words, the whole of the steel industry of this country is at the present time dependent, and, so far as we can see, always will be dependent, until something comes up to replace it, upon the single article—ferro-silicon—made in the electric furnace, by the application of electric power to the simplest and cheapest of all materials, namely, carbon, iron oxide, and silica.

Artificial Abrasives

The artificial abrasives, again, give you another line on the extreme importance of those industries to the general industries. The automobile, at any rate, gives you an idea of the extent to which modern mechanical operations depend upon the use of grinding wheels. Now, the grinding wheel of the newer or artificial abrasive is a different proposition from the grinding wheel of the natural class in two respects: Firstly, the material is better fitted for the job that it has got to do; and, secondly, being an artificial material, it is under better control in its manufacture, and it is possible to get a far greater degree of uniformity than in the use of the natural product. It takes rather an academic point of view to make the comparison to-day, because there is practically no natural abrasive material available here. Before the war about 60 per cent. of the abrasives that were used in this country were artificial abrasives—electric furnace products—the remainder being natural abrasives, chiefly coming from Turkey and Greece. Of course they come from those sources no longer. So, in a time like this, we are in any case entirely dependent upon the artificial abrasives. But whether that were so or not, it is still the fact that the modern technique of grinding and all that that implies—and you engineers know better than I do what it does imply—would be impossible without the use of the artificial abrasives, which the electric furnace has given to the world The use of the grinding machine has grown and extended tremendously, and its use as a serious factor in mechanical operations dates from the time when artificial abrasives began to be used.

I do not think I need go into detail in regard to the numerous other products that I ran over. If you get a rough line on the thought that I have just been trying to give prominence to, you will see how, though the aggregate output of the whole electro-chemical industry of the country may not, if reduced to figures or anything of that kind, look like a thing that could be regarded as of absolute importance to the country, yet, when you come to examine the indispensability of those products (and what I have said in regard to the products that I have mentioned applies to numerous other products as well, which I have not gone into for considerations of time), it is clear that the electro-chemical industries of the country are of extreme importance to practically every one of the basic industries of the country.

Some Concrete Examples

I know of no way of illustrating that better than taking an automobile and looking over its construction, looking over the materials employed therein, to find out to what extent those materials, and the application of the methods used in the manufacture of the automobile, depend upon electro-chemical products.

The American Electro-chemical Society got up an exhibit to indicate this at the last Chemical Industries Exposition in New York, and displayed a list of products used, either in the manufacture of materials used in the automobile or in the tools used, such as high-speed tools for cutting and grinding. And from each of those placards were strung different colored ribbons running to the portions of the automobile in which the particular products were used. And the automobile was a veritable mass of ribbons. You could hardly see the automobile for the ribbons.

Take grinding, for instance; there is hardly a single portion of an automobile from one end of it to the other that has not got to be ground in some form or other. There is not a single bit of steel in the automobile, from ordinary steel stampings and that kind, that is not dependent upon the electro-chemical industry for ferro-silicon. There is not a single one of those parts which have been lightened up so much in the last few years that is not dependent upon the existence and use of ferro-chromium, that is now so widely used. And we could go from one end to another of an automobile and talk the whole evening on it. I was told by a manufacturer at Detroit that the use of the alloy steel alone has reduced the weight of a 4,400-pound automobile to 2,200 pounds, made it infinitely safer and at the same time reduced the cost. That was one of the elements that had permitted of the reduction in cost, which has been such a feature of automobile construction in the last few years.

Again, without the use of the high-speed tool steels, which the products of the electro-chemical industries alone permit, without the use of the grinding wheels which the electric furnace has given to the world, a plant which can manufacture and turn out 500 cars a day would only find it possible to turn out a little more than a hundred—possibly not as much as that—with the same outfit and the same men. You will get an idea, therefore, of what the electro-chemical industry indirectly has permitted the automobile industry to do in the way of cheapening the cost. And it is safe to say, taking all these things together, and others that I have no time to mention, that if it had not been for the growth of the electro-chemical industry in the last fifteen or twenty years, and the application of its products to metallurgy and to the mechanical industries, the automobile, as we know it to-day, could not possibly have existed.

I will give you one other little illustration: Without high-grade ferro-silicon, which is 75 per cent. to 95 per cent. silicon, it would be impossible to manufacture those high-silicon steels which are now exclusively used for core work in electrical apparatus. I cannot begin to enumerate the results of that application, but one of them can be stated baldly in this fashion, that it has permitted the reduction of losses in static transformers to a point where they are now 50 per cent. of what they used to be. That, and that alone, has permitted that reduction. All over the industrial fabric of this country you find these electro-chemical products working their way and permitting advances in industry, advances in manufacture, out of all proportion to the importance of those products themselves. And I did not want to begin to approach my actual subject to-night without having said these few words to give you an idea of what is the general importance of the electro-chemical industry to the country.

Fixation of Nitrogen

So far, I have left one class out altogether, and that is the class of electro-chemical products we do not at present manufacture in this country. And among these the most important are those involving the fixation of atmospheric nitrogen. Now, the fixation of atmospheric nitrogen is, in short, this: Nitrogen exists in the air in an elementary condition. Four-fifths of the atmosphere is nitrogen. But in that form it is of very little industrial value. Before we can utilize it for industrial or agricultural purposes—and its application is principally an agricultural one—we have to combine it, either with oxygen, the other constituent of the air, or with hydrogen, which we can obtain in various ways, to give us nitrates or ammonia salts, or else with calcium carbide, a product of the electric furnace, to form cyanamide. Now, in those forms the nitrogen becomes a valuable manure.

The production of fixed nitrogen compounds by electro-chemical means has grown to a considerable extent, particularly in Norway, in France, in Switzerland to some extent, and also in Germany; also, I may add, in Canada. But we have never been able to introduce it into this country

There are, of course, a number of electro-chemical products that I have not mentioned, some of which are considerable power consumers. Some are of local interest only. For instance, a great deal is being done to-day in the application of the electric furnace in the refining of steel and in steel castings.

In regard to the growth of electric furnace steel for steel casting work, that is, again, a more or less local matter.

Mainly Constructional

East and West—From Coast to Coast

The Grand Trunk Railway began work recently on the erection of a new passenger station in St. Catharines, Ont., near the site of the present depot. It is understood that the new building may be heated with electricity, when completed.

Work has been commenced on the building of a new children's home on Winnipeg Street, Regina, and it is hoped to have it ready for occupation this fall. The Parsons Construction Company are the contractors and Storey and Van Egmond are the architects.

The new 3,000,000-gallon pump recently installed at the waterworks plant in Chatham, Ont., by the Canadian Allis-Chalmers Company, is to be replaced with another pump with a capacity of 3,500,000 to 4,000,000 gallons by the same firm as it has not proved sufficient for the requirements.

As a result of the dry summer, the roads in York County, Ont., are in an excellent state of repair, according to Mr. E. A. James, engineer of the York Highways Commission. "Last year," he states, "we completed all the roads leading into the city. Now 95 of the 230 miles of county roads are completed. Labor and other factors made it necessary for us to postpone further operations until after the war."

The Levis-Jackman government road running through the flooded Beauce district in the province of Quebec, is said to have suffered considerable damage at various points through the recent floods. It is on parts of the road between St. Come and St. Gregoire that the greatest injury has been sustained. Many bridges have been washed away and it is thought that the expenditure necessary for repairs will run into many thousands.

Returning from a tour of inspection in North and West Ontario, Hon. G. Howard Ferguson, Minister of Lands, Mines and Forests, gives an optimistic report regarding agricultural activity in the newly settled sections of the province and the future possibilities for the development of its resources. However, he states that transportation facilities must be bettered in the northland and that money spent in the construction of colonization roads would be wisely invested.

The work of pouring concrete for the storage tanks at the Saskatchewan Farmers' Co-operative Elevator Company at Current River, Port Arthur, is progressing. There are to be more than fifty large storage bins, as well as many smaller ones, in the first unit. The tanks will have a capacity of two million bushels, and the working house will take care of half a million, making a total initial capacity of two and a half million bushels. It is hoped that the elevator will be completed by November.

The Canadian Steel Corporation have had plans filed with the Dominion Government for docks which they propose to construct at Ojibway, Ont., at a cost of \$250,000. The project, it is understood, includes a marine slip, harbor, docks and wharves. A canal running through the corporation's property, 2,500 feet long, will be made 200 feet wide and 25 feet deep and dredged to accommodate boats. It is proposed to build docks on the banks of the canal, and there will be another dock on the river front, 1,000 feet long.

The Imperial Oil Company have applied for a permit to erect a 1,470,000-gallon tank on their property at the foot of Cherry Street, Toronto, for the storage of gasoline. Neither the city architect nor the fire chief were willing, however, to assume the responsibility of authorizing the storage of so large amount of inflammable material above the ground. They have received permission from the board of control to visit a number of places where tanks of a similar nature to that proposed are installed and in operation, and will inspect them before granting the permit.

Deputations from Mount Forest and Fergus recently conferred with the executive committee of the Guelph Board of Trade in regard to a scheme for the establishment of a highway from Owen Sound to Hamilton. The people of Owen Sound are behind this undertaking, wishing to obtain better connections with Guelph and Hamilton. After discussing the matter a committee was appointed from the Guelph board to join with Durham, Arthur, Fergus, and other places in a meeting at Mount Forest to consider the question further with a view to petitioning the Ontario Government.

Personals

Mr. E. W. M. James has been appointed bridge engineer of the Good Roads Department of the Province of Manitoba.

Mr. G. Palmer Howard, manager of the Phoenix Bridge & Iron Works, has been chosen to act on the British Imperial Munitions Board and has recently left Montreal for Washington.

Mr. C. Royer, who for several years has been manager of the L'Air Liquide Society, Montreal, has severed his connection with that firm. Mr. Royer contemplates taking up business as a consulting engineer in the oxy-acetylene process of cutting and welding in general engineering practice.

Mr. W. E. Segsworth, the well-known mining engineer and mine owner, has been appointed by Mr. S. A. Armstrong, director of the military hospitals commission, as his assistant in the vocational training department. He will devote particular attention to the development of better opportunities for the training of disabled returned soldiers by the organization of manufacturers' associations, and of technical workers. Although he is giving his whole time to the work, Mr. Segsworth has refused to accept salary.

Lieut.-Col. D. S. MacInnes, of the Royal Engineers, has been decorated with the Legion of Honor by the French Government. Col. MacInnes, who graduated from the Royal Military College, Kingston, with distinction in 1891, served in the Ashanti Expedition in 1895-6 and commanded the Royal Engineers throughout the defence of Kimberly. He has the Queen's medal with three clasps, and the King's medal with two clasps, also the D.S.O. Under the Canadian Government he was head of the Staff Service, and D. A. Q. M. General at Halifax from 1905 to 1907. He acted as General Staff Officer in the Maritime Provinces for six months and was later transferred to England in March, 1908.

On the canals between London and Liverpool there are nearly 200 locks. On the waterway between Berlin and Hamburg there are only three locks. This is an extreme contrast, but taking the canals of England and Wales altogether, there are 2,377 locks for 3,800 miles of waterways.

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Principal Contents

Conscription Should Also Mean Classification

IT is common knowledge that the sum total of the effective effort of our Canadian army has, in the past, been materially lessened owing to the apparent lack of appreciation, on the part of the military authorities that the training and experience of certain classes of our recruits fit them for special work. This has been particularly and, we believe, glaringly obvious with regard to technically-trained men, for on the one hand we have many such enlisted as privates in the ordinary infantry regiments and quite unable to obtain transfers, while at the same time our engineer officers have been scouring the country for suitable men for their battalions, and finally, having failed to secure them, have been forced to accept unsuitable substitutes. The condition throughout, in a word, is one of "misfits," and the incomprehensible thing about the whole business is that such a state of affairs should exist when it is so obvious and when the remedy could be so easily applied.

What would be thought of any organization in civil life that, having a number of positions to fill requiring varying degrees of skill and ability would employ the required number from the first that offered and distribute them over the works with an utter disregard for their fitness? What degree of efficiency could such an organization expect from its staff? Yet that is very like the methods adopted in the past in the selection of our battalions, so far as technical men at least are concerned.

Now that conscription is in force and the government has been granted the right to say to each citizen of Canada "Come"—and he cometh—surely there is no longer any excuse for placing the engineer otherwise than where his training, experience, and inclination will make him of the greatest service to the Empire. There is little doubt, we trust, that our government will use the greatest care and wisdom in this direction. In so doing they will have the undivided support of all classes, and of none more than the engineers themselves, many of whom have chafed at their inability to help terminate the war. As an example of engineering sentiment we may note a resolution recently passed by the Joint Committee of Technical Organizations (Ontario branch), and which we reproduce hereunder. It recites briefly the weakness in selection in the past, and urges that men be used for work for which they are most nearly fitted. This resolution, we understand, has already been forwarded to the Prime Minister, Sir Robert Borden, and to the Minister of Militia, Sir Edward Kemp. We believe it will appeal to every Canadian citizen, of whatever rank or position in life, as entirely reasonable and businesslike, and calculated to make for the greatest efficiency in our army.

"In view of the many instances coming to the attention of technical men of Canada where men technically trained have in the past been listed in or transferred into branches of the service for which, by training and experience, they were poorly qualified, thereby causing dissatisfaction among the men and reducing the efficiency of the service, and in view of the passage of the Military Service Act in the Dominion Houses of Parliament and the assurance that conscription will be put into operation at an early date, be it

"Resolved, that the Joint Committee of Technical Organizations make suitable representations to the Prime Minister and the Cabinet at Ottawa and others in authority, requesting

(a) That very special effort be made to insure that men be drafted into that branch of the service for which they are most nearly fitted by their training and experience in civil life;

(b) That the Joint Committee of Technical Organizations hereby express their willingness to assist the government to the best of their ability in carrying out the foregoing in the case of those branches of engineering — mining, chemical, or other industry — coming within their scope."

Former Gov. General Member C. S. C. E.

The late Earl Grey, former Governor-General of Canada, who died at Castle Howick, Northumberland, England, on August 29, was an honorary member of the Canadian Society of Civil Engineers, to which he was elected in May, 1905. There are now only six honorary members, another—Sir W. C. Macdonald—having died this year.

The U.S. Engineering Council to Consider Questions of General Interest to Engineers

THE four most prominent engineering organizations in the United States have formed an engineering council along lines almost identical with the joint committees of technical organizations in the various Canadian provinces. The secretary of the United States organization sends us the following information and remarks:

"The formation of an engineering council is the outgrowth of a real need for proper consideration of questions of general interest to engineers and to the public, and to provide the means for united action upon questions of common concern. Many such questions have come up in the past and will arise in greater number in the future. This war has brought out very impressively the actual need for united action of some kind. At present the council is concerned only with four societies, because that seemed the most practical way of getting a group of men together to answer the immeditae needs, but these societies do not assume to speak for all engineering societies in the country. Criticism that they are exclusive in any way is utterly mistaken. There is the hope that such a council, by proving itself effective, may lead to much wider co-operation in a strictly representative body for all engineers, and thus pave the way for a very much larger union in the future.

United Action Wanted

"How can the council be enlarged? By a union of all societies, either as the outgrowth of the present council or by a congress of engineers leading to united action by all societies. The first method will be the most natural one, because many local societies and national societies also have a large membership in the four societies at present concerned. We have three classes of engineers to reach—first, those who are members of local societies and not members of national societies; second, those who are members of national societies and not members of local societies; and, third, those who are members of no society. The last-named class constitutes a very large number in our profession. We are almost as mixed as American citizenship, and we suffer therefrom just as much as America, with a population representing every race and every people in Europe. There can be no question of the enormous advantage of union. That union should be completed by strengthening the existing agencies and not by the formation of new societies. The national societies are thoroughly national, notwithstanding an occasional complaint that they are run by New York. If they have not been able to express the democratic spirit of our country as fully as might be desired, it is the fault of the members in all the states, and not of the city in which the principal offices are located.

"The four societies concerned at present are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. They have come together in pairs from time to time in the past for special purposes, and there have been general conferences on subjects requiring immediate settlement, but until the council was definitely organized in June there was no permanent body to advise all the societies. We have had many fruitful discussions in the past, leading to useful action. The Standardization Committee, which has been organized to represent five societies, has passed upon commercial standards of all kinds. This committee has great possibilities, and it should be enlarged enough so that its influence may become very widespread.

Many problems have already been presented before the council. Its personnel, made up of twenty-four men, representing equally the four societies, is well balanced and judicial. The first duty was necessarily the organization and appointment of standing committees, which have already been reported in the press. These are: (1) Committee on Public Affairs; (2) Committee on Rules; (3) Committee on Finance.

War Committee of Technical Societies

"Another committee, of which Harold W. Buck is chairman, is called the War Committee of Technical Societies. It was appointed to assist any organization in Washington, such as, for instance, the Council of National Defence, the National Research Council, and the Naval Consulting Board, in any way in which it can bring to the attention of the engineers of the country the necessity for thought and help in the numerous problems that arise.

"A council organized by the enlargement of the present engineering council can be very effective in many ways without interfering with the autonomy of any individual society. Every society has some definite purpose of its own and also some which it holds in common with all other societies. One of the latter purposes relates to public service and to co-operation. To the end that all societies may understand fully their opportunity, the committee of which Mr. Foran is chairman has made a complete list of all the societies and their officers, and communications will be sent out inviting co-operation, and it is hoped that the council may be successful in arousing sufficient interest to bring about a larger and better council for all engineers.

"In organizing the council provision was made for the election to membership of other national engineering and technical societies. There is no doubt that rules can be made under which these societies may become members. This will involve consultation and discussion in the future. The office of the council will be in the Engineering Building, 29 West Thirty-ninth Street, New York City."

Union of Canadian Municipalities Holds Successful Convention in London

ON August 27 delegates to the seventh annual convention of the Union of Canadian Municipalities at London, Ont., were formally welcomed to that city by Mayor Stevenson. The convention lasted three days—August 27, 28, 29—and during that time many topics were discussed and a number of important resolutions were passed. The question of the high cost of living, how municipalities can co-operate with the Federal Government to win the war, care of returned soldiers, readjustment after the war, and other questions of national importance were dealt with.

Mr. W. D. Lighthall, of Westmount, honorary secretary-treasurer, presented his annual report at the opening session, reviewing the work of the year. He made particular reference to the attention directed to the revision of the Railway Act by a special committee of the House of Commons. He also stated that while many of the principal cities had neglected to give the necessary financial support to the organization to make its work effective, still much had been done to protect the interests of the various municipalities in federal legislation affecting them.

The work of drafting resolutions was delegated to a resolutions committee, and these were later presented for the consideration of the convention. One resolution of considerable importance to municipalities was that introduced by Ald. H. B. Ashplant, of London, in regard to telephone franchises. He stated that in recent years the Bell Telephone Company had systematically pursued the policy of refusing to pay municipal corporations, as in former years under existing agreements, any financial consideration for its valuable franchise to erect poles and occupy real estate upon which such poles are erected for local service within the municipality. He instanced the experience of London, Hamilton, Woodstock, Windsor, and Kitchener. In these places money had been paid, but when the agreement expired the company refused to renew, and held that they were not obliged to pay under their Dominion charter. The alderman's resolution challenged their legal right to do this, and it was decided to forward it to Ottawa, along with a request to the government to define the law in regard to the matter. Other resolutions were also passed dealing with the following: (1) Calling for a furlough for the remnants of the first contingent; (2) increasing the pay of soldiers; (3) asking legislation against bonusing, and (4) urging the municipalities to do all in their power to conserve food.

Sir Adam Beck was present at the convention, and addressed the delegates in regard to the plans of the Hydro-Electric Power Commission of Ontario. He stated that the commission would require 83,000 additional horse-power this fall, and that this may be expropriated from the developments of private corporations at Niagara Falls who are at present exporting to the United States. He pointed out that while Canada, by treaty, had the right to use 36,000 cubic-second feet of water flow, at present we are only getting the power from 29,000 second-feet, and 115,000 horse-power is being exported from the country. Secretary T. J. Hannigan, of Guelph, also spoke, making mention of the plans which the commission had for hydro radials, but these, he said, were being held in abeyance until the C.N.R. and G.T.P. problems had been disposed of. Mr. Hannigan reiterated Sir Adam's statement that the work of the commission had shown that municipal ownership out of politics is an unqualified success. The convention passed a resolution expressing appreciation of the public services of Sir Adam Beck.

The officers elected for the ensuing year were as follows: President, Mayor W. D. L. Hardie, Lethbridge, Alta.; first vice-president, Ald. Ryan, Three Rivers, Que.; second vice-president, Mayor Burgoyne, St. Catharines; third vice-president, Senator Planta, Nanaimo, B.C.; honorary secretary-treasurer, Mr. W. D. Lighthall, K.C., ex-mayor of Westmount; assistant secretary, Mr. G. S. Wilson, Montreal.

Complete contracting and working drawings for a large graving dock and shipyard at Vancouver, B.C., have been prepared by Mr. A. D. Swan, Montreal. For the moment the work has been delayed, but it is expected that it will soon go ahead, as the subsidy under the Dry Dock Subsidy Act is to be increased from 4 to 4½ per cent.

Stratford Water Supply Problems and Their Method of Solution

An interesting report submitted by Chairman J. J. Mason, of the Water Department of Stratford, Ont., revealed a somewhat unusual situation in connection with that city's water supply, and outlines the manner in which conditions were rectified. Stratford has artesian wells as a source of supply. There are six of these wells delivering water to two pump wells, which also have pipe connections with the river. The supply from the river was not supposed to be used regularly, but only under extreme circumstances. Tests, however, revealed the fact that not only was it in use continually in large quantities, but that it was actually not under control. It was discovered that the valve on the 18-inch river source was either broken or that the water was forcing a course around it and into the catch-basin which supplies river water to the two-pump wells. So far as could be learned, the entire underground system connecting the wells and the river is of glazed tile, with uncaulked joints, which might account for the river water not being under control. Between the catch-basin and the inside pump well there is a second valve, to control the river supply, but a by-pass leading to the outside pump well conducts the water there, and on closing this valve the water flows back through the connecting pipe to the inside well, as this pipe is not controlled by a valve.

High River Level

Another condition which has contributed to the excessive introduction of river water into the city's water is the higher level of the river (about 8 ft.), preventing the artesian wells at their lower level from giving more than a very small part of the available natural flow, especially as the connecting pipe between the outside pump well—into which nearly all the artesian water flows—and the inside pump well, is two feet higher than the bottom of the artesian wells. As it is from the inside pump well that the domestic supply is pumped, the water must rise nearly three feet in the artesian wells before it is available for this purpose.

To remedy the situation, the 18-inch intake into the outside pump well was plugged, shutting off the river supply, which was then made controllable through valve connections to the inside well. An air compressor equipment was also installed, in order to increase the supply from the wells. This scheme proved satisfactory. After the river water was shut off, and before the air compressor was connected, a test was made with the domestic pump, and a supply of natural flow at the rate of 450,000 gallons per 24 hours was developed. Later the air pressure was applied and a supply of 1,750,000 for thirty minutes and 1,400,000 for the two hours following was obtained, using the fire pump. The fire pump was then shut down and the domestic brought into use, pulling at the rate of 1,000,000 gallons, and the city's requirements have since been supplied with artesian water by this pump.

The cost of the installation of the air system was under $900, and the cost of power for one year will be under $300, and, according to the report, the saving from the discontinuance of the use of alum and chlorine will offset the cost of installation and power for the first year.

Improvements Recommended

There are still some improvements which the report recommends. It states that owing to the 8-ft. head which the river has from the intake there will be some soakage into the connecting mains, as the joints are all uncaulked. A great deal of pressure, however, could be taken off the pipes and valves if there was a connection made from these pipes to the G.T.R. supply basin. The water would then flow back into the river through the present north entrance. It is, therefore, suggested that an estimate be made of certain work, with a view to submitting a by-law to the ratepayers next January.

This is as follows: The installation of two storage tanks, each about 90 ft. x 20 ft. x 10 ft. deep, constructed of concrete, using the easterly part of the present G.T.R. basin for this purpose; the making of cut-off connections from both the 15-inch and 18-inch intake pipes to the G.T.R. basin; closing north entrance of river to G.T.R. basin; taking up present glazed pipe connection to wells, and relaying with proper iron pipe caulked joints. It is also recommended that there be installed a duplicate gasoline-driven air compressor.

Commenting on the need for these improvements, the report states: "Had the wells been sunk to an even level and the connections to pump wells placed at proper levels it might have been possible to have obtained sufficient natural flow from the wells for the city's present needs, and thus have saved the overhead charge for power to apply the air pressure."

Canadians Organizing to Replace Vital Products Formerly Supplied by Germany

As a result of the urgency of food production at the present time, the supply of fertilizers is a most important question. The belligerents are trying to starve each other out, Germany by her U-boat warfare and Britain and her allies by a blockade. Germany openly boasts that her natural resources of fertilizer give her a decided advantage over her enemies. This has particular reference to potash, in the production of which, prior to the outbreak of war, Germany had virtually a world-wide monopoly, owing to the vast deposit of potassium-bearing shales of Stassfurt, in Westphalia, from which it is "leached" and evaporated at small cost. The production of this material is, therefore, a most pressing problem for the allies, as it is an essential component of effective agricultural fertilizers. Many sources of obtaining it are known, but all had been neglected prior to the war. However, many of these were immediately exploited, including wood ashes, bittern from the Great Salt Lake, washings from raw wool, fish water from menhaden factories, feldspar, and many others. Of all these sources, feldspar, owing to the wide distribution and vast deposits thereof, afforded the most inviting field for exploitation with an assurance of a permanent and unlimited supply.

New Company Formed

Among the companies that are serving the Empire by taking advantage of this situation and treating feldspar as a source of potash is a firm recently organized and known as the National Potash Corporation, Limited. This company has obtained by lease the property of the Gravenhurst Crushed Granite Company, Ltd., including their rock-crushing equipment, and are establishing a plant for the manufacture of potash according to the best-known methods. A new building is being constructed and plant installed, which will be ready for operation within two or three months. The site, at Gravenhurst, comprises an area of 28 acres, on which are large deposits of feldspar and granite, extending over the whole area. This affords an immense tonnage of feldspar directly in sight, and sufficient for all requirements of the company for years. The plant will have an initial capacity of 38 tons of potash per day.

The process, which is partially a trade secret and otherwise fully covered by patents, is a system of dust and fume collection and precipitation. It has been fully tested and proven out, under actual commercial conditions, in a blast furnace, and also in the plant of the National Portland Cement Company, Ltd., at Durham, Ont., where a large modern plant with eight rotary kilns was utilized. By this process, it is claimed, on an average at least 90 per cent. of the potash content in the feldspar can be released, and it is possible to recover in excess of 95 per cent. of the fumes thus driven off. Samples of the muriate of potash obtained have been analyzed by the Western Precipitation Company, of Los Angeles, Cal., and have been pronounced by them over 95 per cent. pure, a standard heretofore unattainable except by special refining.

A valuable by-product of the operation is the dust driven off from the furnace amidst the gas fumes. This is highly impregnated with potash, and is collected from the fumes in specially-constructed dust-filters ad chambers. When treated according to a secret formula, perfected by the company's chemists, it is claimed to make an excellent fertilizer.

Cement Plant Can Be Used

If a cement plant be used instead of a blast furnace for smelting the feldspar, a different "raw mix" is used, and the residue is converted into Portland Cement. The normal output of a cement plant is in no way impaired by the potash-producing equipment, but it is impossible to get the same output of potash as from a furnace. However, by this method the vast amount of stack dust is no longer a mere waste and annoyance. It is trapped and converted into a very valuable by-product as agricultural fertilizer in the same manner as similar dust is utilized in the blast furnace plant. Tabulations made during the experimental runs for the company at Durham show that this stack dust contains from 3.09 to 10.7 per cent. of alkaline chlorides, mixed with lime and oher constituents, combined to form an excellent fertilizer. In a plant operating eight rotary kilns, it is estimated that from 35 to 60 tons per day of this stack dust were previously dissipated over the countryside.

The discovery of this method of producing potash from feldspar opens up a new and important industry for Canada. The officers of the National Potash Corporation, Ltd., do not fear German competition after the war, as they anticipate that they will, when the plant is fully in operation, be able to produce this material at a cost less than the transatlantic freight from Germany. Mr. E. L. Wettlaufer, of Wettlaufer Brothers, Toronto, is the president of the concern, and Mr. William Calder, of Durham, formerly president and managing director of the National Portland Cement Company, Ltd., is general manager.

Electric Furnaces in France

It is reported from France that the Societe des Mines de la Loire has recently started its first of two electric furnaces for the production of iron, utilizing current from its own generating station.

A Unique Example of Frost Action in Raising Piers Well Below the Frost Line

A QUITE unusual example of frost action in displacing concrete piers is described by Mr. H. J. Gilkey, Chicago, in a current issue of Engineering News-Record. Some 16-ton concrete piers which were heaved this past winter by as much as three inches and subsequently settled back to their original elevation came under the writer's observation. This most unusual and extreme condition cannot be explained by ordinary frost action, but can be accounted for by the piers becoming the pistons of hydraulic jacks, in which frost produced the moving pressure.

This occurred in an important Middle West city at a street ("A") where a bridge was being built by one of the large trunk lines in the course of track-elevation work. Some heaving also occurred at an adjacent street, "B." The abutments and piers at both streets were poured during the summer and autumn of 1916. The bridge steel could not be placed until the following season, hence the piers and abutments carried no load other than their own dead weight.

Moderate Foundation Loads But Poor Drainage

At "A" Street the side piers weigh 31,000 pounds, which includes the steel I-beam grillage embedded in them for the column base to rest upon. The centre piers weigh 36,000 pounds each. The side piers are 8 feet square on the bottom, and the centre piers 8½ feet square. They rest upon solid blue-clay strata, and the unit load of both centre and side piers on the foundation is bout 500 pounds per square foot. The abutments are at the same bottom elevation as the side piers, which is 9 inches higher than the bottom of the centre piers. The unit weight of the abutments is 1,630 pounds per square foot. There was no heaving or settling of the abutments.

At this street, where the most heaving occurred, only the centre and south rows of piers were appreciably affected. The north side of the street was fairly well drained and much drier than the south side; all conditions were favorable to waterlogging on the south side of the street. The street itself has a depression of 6 ft. to the subgrade of the pavement, and so makes a natural hollow for the collection of water. In November, 1916, an 8 in. water main was lowered on the south side of the street. The backfill was thoroughly flooded to prevent future settlement. Cold weather set in, and there was no opportunity for drying out. Drainage to the sewer was very slight.

The bottom of the north side piers was about 4½ ft. below the ground surface, of the centre piers 4 ft., and of the south piers 3½ ft.

Piers Found Heaved in Early Spring

The grillages (embedded in the concrete) were all set with extreme care, and were checked and re-checked for elevation. From the latter part of November, 1916, no further levels were taken until March 15, 1917. The discovery was then made that the south row of piers had heaved by amounts varying from 0.07 to 0.22 ft., or 2¾ in. The centre row showed heaving ranging from 0.01 to 0.09 ft. or 1⅛ in. The north row showed nothing in excess of ¼ to ⅛ in., most of which could have been in the original setting.

After this was discovered, levels were taken at the four corners and centre of each grillage plate at intervals of three to five days. As the ground thawed the piers settled back into position until the highest corner of any grillage was but 0.06 ft., or ¾ in. above what it should be. A settlement of as much as 0.18 ft., or 2⅛ in., is shown.

Probably No Expansion of Freezing Ground Under Footings

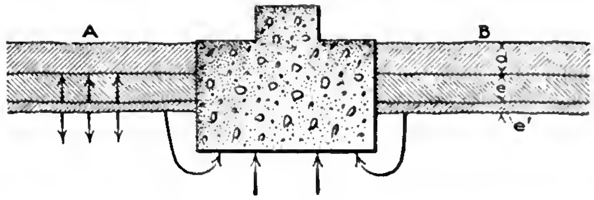
The question, of course, arises as to how this action took place. It seems safe to assume that freezing was the cause. The usual explanation is that the frost simply penetrated to a level below the bottom of the piers and heaved them by direct action, but this does not seem adequate for the following reasons:

1. It is very doubtful if the frost penetrated as low as the bottom of the piers. Notwithstanding the unusually severe winter, it is probable that the adjoining abutments were more or less of a protection.

2. If the frost did penetrate to below the bottom of the piers, there could not have been more than from 6 in. to 1 ft. of frost at the most. This thickness of frost could not possibly heave a pier nearly three inches. Water expands about one-tenth of its volume upon freezing. The expansion of water-soaked soil would not be greatly in excess of this, if as much. That would mean but 0.1 ft. upheaval for a whole foot of frost under the pier.

Action Similar to Hydraulic Jack

The writer is rather inclined to attribute the rising of action similar to that of an hydraulic jack. The pier would be analogous to the piston of the jack, and the



Piers were plungers in a big natural jack.

water or semi-fluid mud is forced under the pier by the pressure from the freezing expanding strata nearer the surface. The accompanying sketch will illustrate.

Let AB represent the surface of the ground. Suppose the ground to freeze to a depth d, such that the frozen layer becomes rigid and unyielding. Let the frost then penetrate to an additional depth e. The layer e expands in freezing. It exerts a pressure both upward and downward. The frozen mass d is unyielding, and if the weight of the pier is less than the force required to break the rigid layer, the water and semi-fluid clay will be forced upward like a piston. Such an action would account for any amount of heaving.

The experience at "B" Street certainly disproves the theory of direct frost action under the pier and seems to agree well with the explanation offered.

At this street, where there is practically no depression, only three or four piers out of a total of 42 (14 in a row) were found to have been raised. These varied from ⅜ in. to 1¼ in., only one pier having been heaved the latter amount. But at this street the bottom of no pier was less than 5½ ft. below the ground surface. It is certain that no frost penetrated to that depth. So far as the writer can see the preceding explanation is the only possible one that could cover the "B" Street situation. It is unfortunate that test borings for depth of frost penetration were not made at both streets, in order that more exact information might be had on this point.

A Quite Unusual Occurrence

In concluding it might be well to add that the pouring of piers and leaving them to remain unloaded for one or more seasons has not been unusual in this work. Neither have any of the conditions such as the depression and water-soaked condition of the subway differed from those in several that have been previously constructed. In many instances the piers were built for several years before the bridge steel was erected upon them. But in no case has any upheaval such as the preceding been discovered.

This might be due to one of two causes: (1) The steel was usually placed in the spring or summer season, and the piers might have heaved and settled again without being detected; or (2) the unusual severity of the past winter may have caused the disturbance. Several of the engineers in charge of other track elevation work in the locality were consulted when the discovery was first made, and none of them reported anything like this in his experience.

However, the chief engineer of one of the street railway companies recently stated that nearly all the track-elevation bridges in the locality raised in the winter and lowered in the summer, and that the street cars had as much as two or three inches of extra clearance during the winter months.

Methods of Large Construction Companies in Selling Services for Private Work

By Leonard C. Watson*

CONTRACTS on some privately-owned work are let on cost plus fixed sum or percentage profit basis, and for these aggressive selling is needed. I am pleased to say that these types of contracts are growing in popularity. Some of the arguments which the salesman can use to persuade a buyer to accept them are:

The work can be started before the plans are made, and six weeks' time can be saved.

The contractor's and the owner's interests are mutual. Therefore, better and cheaper results are obtained than with a lump sum contract where the parties' interests are antagonistic.

Changes, either additions or deductions, can easily be made at cost.

The mutuality affects the design, purchasing of material, and sub-contracts, obtaining of labor and finance; eliminates frictions with the inspector.

The first step necessary is to seek out opportunities for obtaining these types of contracts. The most effective method is to visit cities and towns seeking information from all available sources, including calling on the various parties who are thought to be considering the erection of new buildings. This method is slow and expensive. One man cannot cover much territory and do it well. This scouting, however, does not take the best men, and only infrequently brings the scout in touch with the high executive of the company who has the final say in awarding a contract. It should be so well done, however, that it leaves a lasting favorable impression on every one seen, as thereby subsequent work is made much easier. The creation and maintenance of a wide acquaintance and keeping in touch with those who have been met are a valuable asset leading to new business, though they may not bring immediate results. The construction information agencies and the news items in the technical press are too late to be useful, as information is not made public until the party is ready to receive bids.

A less expensive way to cover a large field is by advertising literature. The construction company seeking day work fixed sum profit contracts needs to reach directly the executive official in whose hands rests the final decision as to awarding a contract. As these men change from time to time, it is necessary to keep in touch with one or two others who may be promoted. It is also necessary to be on good terms with the engineer in the employ of the executive, in order to be able to execute a contract to the best interests of all concerned. The engineer, however, very seldom has much influence in regard to awarding contracts, although if he is hostile it may either make it impossible to obtain the contract or make the latter undesirable if obtained. Therefore, the style of advertising must be adapted to these needs.

Experience has shown that the most effective, though perhaps more expensive way, is by compiling carefully a mailing list of the executives and directors of companies whom it is desired to interest; of large investors and some of the engineering and architectural profession. It can be taken for granted that little, if any, of the advertising literature will be kept or referred to later. It must, therefore, be so designed as to tell its story and make an impression that will last until further matter has been received.

The writer's company has, after various experiments, decided on the plan of sending something once a month to its mailing list. This necessitates something bright, interesting, and brief, and therefore not very expensive in itself. If the advertising makes enough impression on the recipient to draw an enquiry it has done its work. These are very desirable, as they bring the salesman and buyer together on a very pleasant basis, greatly increasing the former's effectiveness. Then the real selling campaign begins.

Personality and Ability Count

No fixed rules can be laid down of methods to be followed. The principle underlying all methods is to win the confidence and good-will of the prospective client by direct personal contact and by this means obtain his order. Confidence in the salesman's sincerity and knowledge is absolutely necessary. He is presumed to be the mirror that reflects the company. As-

* President Aberthaw Construction Company, before World Salesmanship Congress.

sumed that he is a total stranger at the start. Write a letter for an appointment; send some information and perhaps literature to make the prospect want more and be willing to see you. Then get a letter of introduction from a mutual friend. This will get you past the office boy. The representative who calls must be of pleasing personality, with ability to meet the prospect on his own footing and to make a good impression. He should be able to answer almost any question asked him regarding the operating details of his own company intelligently and authoritatively. He must be perfectly frank and truthful, even if it results in losing an order. A favorable impression is left that some time will help the salesman's company. Many salesmen fall down by their failure to tell the truth when it hurts.

He must everlastingly present the main issues, being careful not to talk of details, which will only weary the buyer, and certainly will not tend to obtain his signature. The decision must be hammered through on principles.

It is desirable that he should know enough about other lines of work, so that he can, without being officious, offer advice wisely on matters concerning the business of the prospective client. If he is able to do this latter he is sure to make a real impression. This requires a salesman of unusual ability and experience.

After making a man's acquaintance the steps which follow are easier to determine upon. They consist in part of getting his friends to write or see him in your behalf. He is affected most by successful competitors in his own line of business who write or see him and endorse your company. Induce him to write to ten or more of your recent clients, so as to get disinterested opinion from those who have had recent experience with you as to your worthiness. If they come from men respected in the business world they will frequently land the job. This implies that your company is absolutely reliable, honest, trustworthy, and frank in all its dealings, as well as thoroughly competent. Otherwise you would be taking grave chances to entrust your reputation to past clients who know you so well by recent intimate experience.

What Have You to Sell?

This leads again to the question, What has a construction company to sell under the cost plus fixed sum type of contract? Its service—that is, its ability to construct a given piece of work quickly, economically, and safely, to the complete satisfaction of the owner and his engineer, so that he will be satisfied, or more than satisfied, with the final result, and can be relied upon as a salesman to help you sell subsequent work on account of his enthusiastic endorsement of the service he has received. It is certain that a company doing this type of business must give better service than the ordinary run of contractors in order to make it worth the owner's while to employ the company to do its work rather than another contractor as the result of competitive bids. The construction company must, therefore, have a most efficient organization to back up its selling force.

It has been found desirable, and almost necessary, for the salesman to keep in touch with the owner and the contract fom start to finish, in order to see that every detail of the agreement with the owner, both written and verbal, is lived up to—not only in letter, but in spirit, and, if possible, that results may be even better than those promised when the job was sold.

The salesman must be somewhat of a free lance, particularly in regard to his time, so that he can keep an appointment at the purchaser's convenience without fail. It requires a much different temperament for a man whose time is largely devoted to selling and not fully occupied, from the man who executes the work and must be always available to supervise details of construction, and who is largely absorbed in numerous details which do not give him time for reflection and decision on the larger problems which come before the salesman. Therefore, the two activities cannot be combined in one man.

Combined Sweeper and Loading Machine

A NEW type of combined sweeper and loading machine for use on roads and streets has just been placed on the market by an English firm, and is described in the Engineer as follows:

It is constructed in the form of a trailer for attachment to horse-drawn or power-driven wagons. It is geared to travel ordinarily at the rate of three miles per hour, but it has been proved to be capable of working satisfactorily when drawn at six miles per hour. The working speed will, naturally, depend on the condition of the road and the amount of refuse on the surface.

During the trials of the machine it has been found capable of filling a two-ton wagon in six minutes when drawn by horses—this test being made under the worst possible conditions, directly after rain on a macadam road—but the usual time occupied, when the vehicle travels at the rate of three miles per hour, is from twelve to sixteen minutes, the actual time being dependent, of course, on the state of the road.

In order that its work may be performed equally effectively under any weather conditions, and dust removed without causing more than the minimum of inconvenience, the working parts of the machine and brush have been enclosed entirely down to the road surface.

Constructional Features

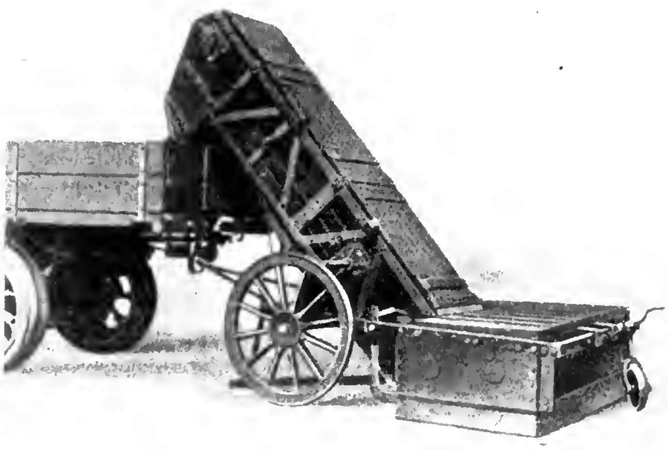
From the illustrations it will be seen that the machine consists of steel frame supported on two road wheels, and a small trailer wheel situated in the rear of machine. On this frame, and situated immediately behind and over the main axle, are two malleable iron brackets. These brackets carry the conveyor casing and refuse trough, which are pivoted on an axle supported by them, this arrangement having been adopted in order to allow the trough to lift, if it should come in contact with any solid obstruction in the road. The refuse trough is intended to travel as near as possible to the road surface without contact, and it situated immediately in front of the brush. The brush, which is 5 ft. 10 in. in length and 20 in. in diameter, is driven in a direction contrary to the travel of the machine, by means of a chain and sprocket wheel fixed on the main axle, and it sweeps the refuse over a width of 5 ft. 10 in. direct into the refuse trough. In this trough revolve two helical scrolls, which are constructed of rubber. They are inclined in opposite directions, so as to pass the refuse towards the centre of the machine and to force it over a small ridge which divides the trough from the boot of a conveyor. From this boot the refuse is taken by buckets, 24 in. wide and mounted on endless chains, up the conveyor and delivered down a chute into the wagon. The small ridge between the trough and conveyor boot consists of a roller, which revolves slowly in a forward direction so as to prevent any accumulation on the ridge.

The brushes are constructed in short lengths, and the brush axle is divided into three sections, fitted with universal joints, suspended in two sliding central bearings, in addition to the side bearings, so as to allow the central section of the brush automatically to adjust itself to suit the camber of road. The makers claim that in this way an even pressure of the brush throughout its entire length on the surface of the road is obtained, and that there is thus no necessity to bring heavy pressure to bear on the centre of the brush in order that the ends may touch the road surface. This, they point out, should considerably prolong the life of the brushes, and, incidentally, prevent damage being done to the road surface. Furthermore, by setting back the central section of brush, the refuse swept forward by the two side sections is, it is stated, directed towards the centre, and greater efficency is obtained.

The power to drive the machine is derived from two sprocket wheels on the main axle, which revolve with the road wheel, and both are fitted with throw-out gear. One sprocket drives the brush axle, and the other the conveyor, from the lower spindle of which the power is derived for driving the scroll axle in the refuse trough, and the small roller between the trough and conveyor boot. The hubs of the road wheels are fitted with ratchet attachments, to enable the machne to work while turning corners.

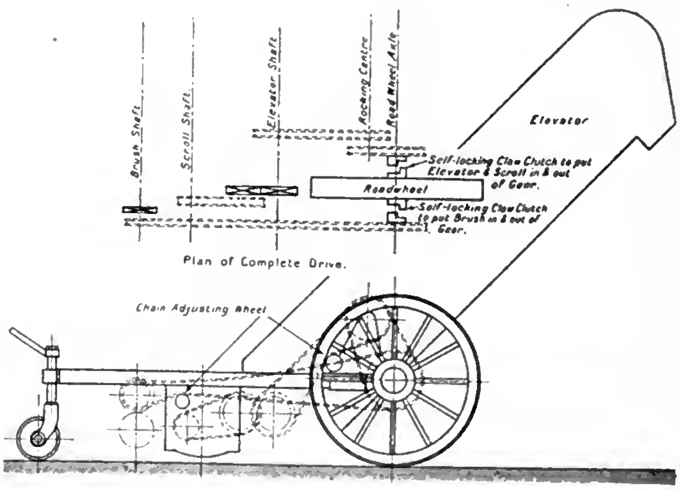
Simple to Operate

The makers also claim that, as the only important adjustments are the regulation of the brush pressure and the height of the refuse trough, the machine can be



Showing equipment in operation.

entrusted to any attendant of ordinary intelligence. In fact, simplicity of construction, combined with the greatest possible strength whilst keeping the weight within moderate limits, have been the principal aim of the manufacturers. At the same time, they, quite rightly, point out that one fact cannot be too strongly impressed upon all who control the working of these machines, and that is that "there is a limit of capacity to every machine," and that in these days when power-driven road brushes can heap the refuse from a large width of road into a narrow swatch many inches deep, one can very easily exceed the limit of loading capacity. This results in the refuse being piled up between the brushes and refuse pan, or even in front of the latter, and grave risk would be run of damaging the machine unless "a safety valve" had been added in the form of a shearing pin connecting the driving sprocket



Showing construction details.

wheels. A device of this kind, which can be replaced in a few minutes if the breaking point has been reached, has, therefore, been embodied in the design.

The spreader in front of the refuse-pan is designed to level down any heaps of refuse, and by keeping the strain regular from one end to the other of the scrolls, to prevent blocking and ensure a regular feed to the elevating buckets.

The following comparative figures further explain the equipment:

What It Will Do

At the present time, to clear a road one mile in length and 30 ft. wide, an ordinary road-brush will be used for at least 2½ hours to sweep to the side of the road, say, twelve tons of refuse. Three wagons and six men will be required to remove this amount to the tip, and it will take six hours, on the average, to do the carting. Cost: One man with road-brush and horse, 2½ hours; six men with three wagons and three horses, six hours. With this loading machine two men with two horses on a two-ton capacity wagon will fill the wagon in fifteen minutes. The wagon is then sent to the tip with one horse in charge of one man. A second wagon is filled in twenty minutes—an allowance of five minutes being made to unhook and refix the loader. The third wagon is also filled in twenty minutes, by which time the first wagon would have returned, and the mile of road would be cleared after each wagon had been filled twice. The work, therefore, would be completed in less than two hours with four men, four horses, and three wagons, and would effect a saving of 30½ hours in man's time and 12½ hours in horses' time. In this calculation the loading machine has been taken at fifteen minutes, which is nearly the maximum time reached in practice, and each additional ton per mile would add to the advantage gained by the loading machine. The amount of road surface swept and cleared in one hour's work behind a power-driven lorry, at six miles per hour, is estimated at 20,000 square yards. The weight of machine, with its triangular attachment bar, is given as being, approximately, 26 cwt.

Paving and Road Building Results

As Gained by Many Years Experience, with Various Types, in Ann Arbor, Mich.

By Manley Osgood*

THE first pavements constructed were laid in 1898 and 1899. Bricks on concrete foundations were used, with soft filler between the brick. This pavement will be twenty years old next summer, and is in fair condition for a pavement of that age, although somewhat rough, due to uequal settling of the individual bricks.

From 1900 to 1903, inclusive, asphalt block laid on nothing but compacted sand and gravel foundation was tried, 32,500 square yards of this type being laid on some of the heaviest traveled streets in the city. As early as 1908 it was realized that some measure must be adopted to preserve this pavement, and it was given a carpet coating of tar and sand. The tar and sand adhere very well to the asphaltic surface of this block, and carpeting has prolonged the life of this type of pavement many years. On these streets such a coating lasts for about four years. It may be said right here that Ann Arbor learned that any necessary patching of a pavement should be done with the same material as that of the pavement to be patched. The repairing of asphalt block streets with vitrified brick or concrete was an absolute failure.

In 1913 one city block of this type of pavement was replaced with standard vitrified brick on a concrete foundation. In 1916 the second block was replaced, and this year a third block is being replaced. These blocks are in down-town districts, where heaviest traffic prevails. It is proposed that in districts where the traffic is not so heavy the asphaltic block be used for a foundation to be surfaced with asphaltic concrete or sheet asphalt.

Tarred Concrete Pavement

From 1909 to 1914, inclusive, the more or less famous tarred concrete or "Dollarway" pavement was laid exclusively. The first pavement of this type contained 1,880 square yards. The materials were purchased and the work of construction done by the city, and every precaution was used to procure good results. This pavement was laid for $1.03 per square yard, including curbing and grading, or for 78 cents per square yard for the pavement only. It had been quite difficult to obtain the necessary majority signatures for a pavement previous to this time, but when the news spread that this pavement had been constructed so cheaply, petitions commenced pouring into the Common Council from all parts of the city, and all expressed preference for a similar pavement. The result was that the city started paving streets as fast as possible with the machinery and labor available. In the next two years, 1910 and 1911, during which 58 per cent. of all of this type of pavement now in the city was laid, everything was sacrificed to first cost. The small batch concrete mixer first used was replaced by a continuous mixer of greater capacity. Cement was never tested unless it was very evident that it did not come up to the specifications. Bank-run gravel was used in both courses, without screening or washing and especially in 1911, when the greatest yardage was laid, there was not sufficient or sufficiently competent supervision or inspection to insure even the best obtainable bank-run gravel. The pavement was reduced from a total thickness of 7 in. to a total thickness of 6 in., making the lower course 4½ in. thick and the upper course 1½ in. thick. During these two years this type of pavement was promoted throughout the entire country. The low cost was the most advertised feature, and the results obtained in Ann Arbor were used as examples of remarkable savings.

Frequent Repairs

As I said before, after the completion of the first pavement, the people were very enthusiastic about this type of pavement. It continued to grow in favor in 1910 and 1911; then the tide commenced slowly to turn. It became evident to all that it was necessary to recarpet the concrete every two or three years, in some cases, varying with traffic conditions, even every year. Those who owned automobiles did not like the throwing up of the tar and sand on the under side of the fenders. In some places, where the carpeting peeled off, the concrete commenced to ravel, and sections, varying in size, had to be cut out and replaced with better material. It was then realized that reducing the first cost to a minimum had caused a heavy burden of maintenance and repair. These pavements must be kept carpeted to preserve the concrete underneath as long as possible.

Greater Attention to Quality of Materials

In 1913 and 1914 the same type of pavement was laid, but greater precautions were taken in the selection of material. During the latter year only washed sand was used in the top course. Results show that the greater care and increased cost were justified.

Value of Careful Supervision

In 1915 the city returned to standard types of pavement. Reinforced concrete, asphaltic concrete on cement concrete foundation, and vitrified brick on concrete foundation have all been laid, with very good results. A further change was made in 1915 from municipal to contract work. Inspection of all material and workmanship has been very rigid except for three blocks of asphaltic concrete surface. Due to the resignation of an inspector before the completion of this street and the inability to find a man to replace him, the last three blocks of asphaltic surfacing were laid with only intermittent inspection. These three blocks have developed surface holes, due to insufficient thickness of surfacing in some cases and improper mixture in others, while the remainder of the district, some fourteen blocks, is in excellent condition. The concrete base, as seen through these holes in the asphaltic surfacing, is in excellent condition and a very good grade of concrete. The defective surface has been once and must be again repaired under the condition of a five-year maintenance bond.

Cheap Cost Means High Maintenance

From the foregoing it may be seen that this city has passed through the same stages of paving development that are experienced in many American cities. These

*City Engineer.

experiences can lead to but the following conclusions: That good materials and proper methods, as well as careful workmanship, must be used to make a good pavement of any type, and that the pavement cheap in the first cost is quite apt to be considerably more expensive in the final accounting. Concrete pavements as a class are not condemned by use because of those constructed in 1910 and 1911. We believe that each type of pavement has a place, and it is the business of the municipal engineer to know where each type belongs. The wishes of the property-owners should be given consideration, but should not be the deciding factor in the choice of kind of pavement for any particular street or district.

Recent Developments

The improvements in the standard types of paving during the past few years have not been very numerous. In concrete paving, better aggregates are being insisted upon, and, in some cases, richer mixtures. There have also been several improvements in the finishing of concrete pavements, one of the latest ones being by means of a broad leather belt moved transversely across the crown of the street. In the brick pavement, the wire-cut brick with square edges was introduced several years ago, but has only within the last two years become very generally used. The square edges and rough side surfaces of this brick are quite an improvement over the old repressed type. During the past year also the monolithic and semi-monolithic types of brick pavement have been developed. In these, in place of the sand cushion formerly used, the brick are laid either directly upon the green concrete foundation or upon a mortar bed. This type of pavement—for it is really but one type—properly constructed, has the following advantages over the former type where the concrete base and brick surfacing were separated by the sand cushion:

First—It ensures that the rolling and grouting of brick will follow closely after the laying.

Second—It ensures a firm and separate bearing for each brick.

Third—It eliminates the danger of sand floating or being squeezed up into the joints, thus preventing the proper penetration of grout filler. This does away with many of the transverse cracks and the sections where the brick are not properly bonded, faults which were quite common in the former type of brick paving.

Fourth—The monolithic construction eliminates the necessity for marginal curb on country roads.

Brick Pavements on Hillsides

A method of construction of brick pavement on hillsides, known as the "dual" type, has been developed comparatively recently. A strip 7 or 8 ft. wide along each side of the improvement is laid with "hillside" blocks, which give a corrugated effect to aid horse-driven traffic. The centre of the improvement between these two strips is laid with the ordinary smooth brick, and is intended primarily for automobile traffic. This type of construction separates very effectively the slow and rapid moving traffic.

Novel Type of Construction

In one of our cities this year is being tried a novel type of construction. A pavement 18 ft. wide, in this case of asphalt confined between headers of concrete built as a part of the concrete foundation, is constructed along the centre of the street, and the strip along each side between this pavement and the curb is built of earth or gravel, as are the shoulders of the paved country roadway. It will be watched with interest to see if this type of construction is adapted to the traffic on a city street.

Road Building

The road building of a municipality, as distinguished from paving, is largely the preparation and maintenance of unpaved streets. In and about Ann Arbor gravel is plentiful, and the road building is, therefore, limited to the spreading of gravel over the surface of the road to be improved, leaving it for traffic to roll down. If the gravel surface wears full of holes, another gravel surface is applied, until, in many cases, the roadways have been built, in just this manner, higher than the sidewalks on either side. The correct method of building and maintaining such streets or roads is much the same, whether the surfacing material or "metal" be gravel, broken stone, or some other suitable local material. If the street to be improved is not curbed, or if the graveling or improving is not to be carried from curb to curb on a street that is curbed, shoulders should be cut the proper distance apart to provide for surfacing the width desired. The gravel should be spread evenly between the shoulders or between the curbs, as the case may be, with all the larger stone or coarser gravel at the bottom and the finer material on top, and in such manner that it will pack uniformly. The entire road surface, from curb to curb or from side ditch to side ditch, should then be rolled, commencing at the sides and working toward the centre. When holes appear in the gravel surface, they may often be cared for by cutting square edges about the hole and filling with gravel, tamped in; but it is useless to throw small quantities of gravel into these holes without cutting the edges square. When the surfacing becomes sufficiently worn or raveled to require re-graveling, which, if the ordinarily traveled street is properly constructed and maintained, will not be for several years, the fine dust should be scraped from the surface, the gravel or "metal" should be scarified and loosened, the necessary amount of fresh gravel or stone spread over the surface, and then the whole rolled until it is properly consolidated into an even surface with the proper crown and at proper grade or elevations.

Value of "Dragging"

The most important part of road building or road making—and I speak of roads as distinguished from pavements — is the dragging or floating. Even an earth road, if dragged frequently after each rain until the surface becomes dry enough to prevent rutting, may be kept in very good condition. The department in charge of the maintenance of unpaved streets should be provided with a sufficient number of these drags or floats, and they should be used after every softening of the road surface until the surface is again hard enough to prevent rutting.

The use of molybdenum as an ingredient for special steels is likely to be considerably increased as the result of experience gained during the war. The Germans have been using molybdenum steel in considerable quantities for their big guns, and the famous French "75" owes its long life to its lining of molybdenum steel. Tungsten steels, when used for the same purpose, were found to develop a coarse crystalline structure after a limited number of rounds had been fired, rendering the guns practically useless, says the "Ironmonger." By employing molybdenum steel this defect has been overcome and the guns seem to last indefinitely.

Municipal Problems in Western Provinces

By Hon. J. W. Armstrong*

THE Canadian municipality is the civic unit into which the provinces are divided, and, in common with the provincial and Dominion representative bodies, enjoys the right, through its elected council, to pass legislation, possesses executive and administrative authority, and performs an important part in determining the character of our national life.

While the municipality is a creation of the provincial government, and its authority may be limited by that body at will, there is a fixed, unwritten understanding that the municipality shall be given as its sphere of action control of all matters that are of such a local nature that they can be successfully dealt with by its own organization. It is essentially the people's government; in its modern form was born with democracy, and its authority has been extended with the enlargement of the privileges of the people to participate more and more in matters of government.

Two Phases of Municipal Authority

We recognize two phases of municipal authority: The one, in which the municipality acts independently. The council enacts and administers its own by-laws, guided only by the dictates of its own judgment, and fully manages a large portion of its receipts and expenditures, amounting in the Prairie Provinces to $27,000,000 annually, while the expenditure by the provincial governments of these provinces is little more than half this sum. Secondly, the municipality acts dependently on a department of the provincial government in a large and growing number of questions in which the control and supervision is retained by the department, and the council is given jurisdiction in the local administration of the Act.

This practice of delegating executive and administrative authority to the municipality is a most satisfactory way of suiting legislation to the varied conditions that naturally exist in any province, and enables a happy solution of many vexed questions that are viewed from as many different angles as there are effects to be produced by their enforcement. A large field is covered by this class of provincial statutes, and includes laws on education, public improvements, public health, social welfare, those relating to hospitals, administration of justice, town planning and hotel accommodation, and the large subject of public utilities, always a live question in this city, is just waiting a favorable opportunity to present its claim for consideration.

Great Range of Influences

It is only when we contemplate the great range of subjects covered by the administration by municipalities, all of which intimately touch the home life of the people and require to be moulded to meet successfully the diversified conditions that exist in these Western provinces that we fully realize to what extent the physical, moral, and intellectual well-being of our population, especially in the rural districts, depends upon the character of the government these organizations are able to furnish.

Every one of these departments presents its own problem, to all municipalities, where jurisdiction is given. We meet them in their normal form in the well-populated areas of the West, and we meet them in their abnormal and purely Western shape in the districts that are not yet well enough settled to admit of efficient management by ordinary municipal machinery.

Up-to-Date Administrations

The former class are examples of efficient and up-to-date administration. Fired with youthful enterprise and ambition, they adopt the latest methods of procedure, and take advantage of every opportunity to improve conditions in every department. They readily receive suggestions from the eminent authorities on municipal matters, who meet them at the annual conventions, and from other available sources, carefully considered selections from which are regularly incorporated into the Municipal Act, and keep the law in good form. Care is exercised in placing well-qualified officials in charge of the executive end of the work, and altogether these organizations will compare favorably with the most advanced rural municipalities in the older provinces of Canada.

In the latter class we meet a different situation. Here the lack of continuity of settlement interferes with the efficient work of the machinery and Westernizes all municipal questions. With true Western spirit, these new municipalities are bravely, and with a degree of success, dealing with their local problems, that on this account are beset with unusual difficulties, which happily, however, lessen automatically with the increase in population.

Over a large part of the Prairie Provinces a considerable percentage of unoccupied and non-producing good land is interspersed in the settled districts. They are not unoccupied because they are not fit for settlement, but because their productive possibilities have made them a most attractive field for investment, and led to their alienation from the Crown, with the expectation of profit-making in the transaction.

Settlement of Vacant Lands

The settlement of these vacant lands is the greatest material blessing that could be bestowed upon Canada, and the West in particular, and next to this might be considered the extension of our settlement boundaries, under guidance, beyond the present frontiers. It constitutes our most important and practical Western problem.

It is not an exclusively municipal problem. Few problems are, and there are few questions before any branch of government that do not affect the municipality in their administration to a greater or less degree.

Populate these lands and every institution of government will in a large measure become effective. The full benefit of our elementary educational system will reach every home. The board of health will be able to extend its assistance and instruction on sanitation to every locality. Hospital treatment and the service of trained nurses will be available wherever required. An opportunity to develop the higher faculties of the mind will be afforded through an elevating community life. Good roads and easy transportation for farm produce

* Municipal Commissioner of Manitoba, at the recent National Conference of the Civic Improvement League, Winnipeg.

not more than four parts by weight of suspended matter in 100,000 parts of effluent.

The firm was also required to submit to the city engineer for his perusal, but not for his approval, drawings showing the arrangements they proposed to adopt.

It will then be understood from this that, whatever merit there is in the scheme, which the association will have the opportunity of inspecting, the credit thereof belongs entirely to Messrs. Jones & Atwood, and in no sense to the author, with the exception, perhaps, of some details suggested by him.

Less Air and Continuous Operation

It was obvious that if the activated sludge process of purification was to become one which sewage engineers could entertain, the quantity of air used in the Salford experiment when the deputation visited those works must be greatly reduced, so as to bring the cost of pumping air within reasonable limits, and, as has already been remarked, it was extremely desirable that a continuous method should be found. The experimental plant at Worcester is an effort to give effect to these two desiderata.

It was clear from the investigations of Dr. Fowler and others that the purification was effected by keeping the activated sludge which held the myriads of oxidizing organisms in intimate contact with the liquid to be purified and by keeping the organisms supplied with a sufficiency of oxygen from the air. Hence the more finely the sludge was broken up, and the more evenly it was distributed throughout the mass of liquid the more intimate was the contact between the solids and liquid. The question, therefore, became, What is the most efficient method of producing fine subdivision and suspension of the solids

Nothing seemed so effective to this end as agitation of the entire mass of liquid and solids by the blowing in of atmospheric air, while this method possessed the further advantage of supplying the necessary oxygen to the organisms.

As the need of the latter requires only a fraction of the air demanded for the former, the economical problem becomes reduced to one of devising a method of suspending the sludge throughout the mass of liquid with the minimum consumption of air. The plant installed at the Worcester Sewage Works is Messrs. Jones & Attwood's contribution towards the solution of this problem.

It will easily be seen from what has been said that it is important to remove detritus and all other heavy matter in the sewage before passing it into the aeration tank. All large, suspended, non-putrefactive, organic matter should also be screened, and as these substances neither need purification themselves, nor contribute to the purifying process, they are "matter in the wrong place," and should be eliminated.

Description of Tank

The portion of the tank handed over to Messrs. Jones & Attwood for their experiment had a net water capacity, at a depth of 17 ft. 3 in., of 626,000 gallons. It consisted of a rectangular tank, 86 ft. 3 in. by 78 ft. by 18 ft. deep from coping to floor. It was divided into nine longitudinal bays extending from the inlet channel, which ran across the entire width of the tank, to its opposite end, by eight division walls, 9 in. thick, all the bays having a water communication between them at the lower or outlet end.

These longitudinal bays were subdivided by three transverse walls, finally forming 36 rectangular bays, each 21 ft. long by 8 ft. wide and 18 ft. deep. Of these 20 are devoted to aeration, 8 to the settlement of the sludge, and the remaining 8 are at present not in use.

Reverting to the Salford tank, the arrangement for aeration consisted of air pipes laid on the floor of the tank, which was flat, containing perforations for the exit of air spaced about a foot apart. Any material increase in the distance between the air exits was found to result in the settlement of sludge on the floor in the intervening spaces.

For the purpose of increasing the intervals between the air jets, and to avoid the piling up of sludge on the floor of the tank, a series of concrete ridges and furrows have been constructed over the entire floor area of the aeration tank, the ridges occupying the spaces on which the sludge would accumulate if the floor were flat. In the furrows, porous tiles, called "diffusers," are laid, through which the air is delivered to the liquid. The author thinks these are a distinct improvement upon the plain jets. By means of these ridges the distances between the air outlets have been greatly increased.

Spacing of Diffusers

In the first longitudinal set of bays, which receives the raw sewage, the rows of diffusers, which run across the bays and are a foot in width, are separated by a distance of 5 ft. By these diffusers a vertical circulation of the water is set up, returning upon itself, while the air escapes at the surface. In the remaining aeration bays a somewhat different arrangement of ridging has been adopted, whereby the distance between the rows of diffusers is increased to 10 ft., thereby reducing the consumption to one-half of the former series for a given area of tank. Each row consists of eight diffusers, each 1 ft. square, laid transversely across the bay. The circulation resulting from this arrangement, instead of being local to each row of diffusers, as is the case in the first longitudinal bay, the air drives the liquid forward.

Advantage is taken of this to create a horizontal circulation around two contiguous series of longitudinal bays; a portion of the water returns, and a portion is taken by the next pair to travel in a horizontal circuit in these.

The Settling Bays

From these the now oxidized liquid, containing its full complement of suspended sludge, passes into the settling bays. These eight bays are formed into four tanks, having their floors shaped into inverted pyramids sloped at an angle of 60 degrees from the horizontal. At the apex of each pyramid a sludge lift is provided, consisting simply of a 6 in. pipe, in the bottom of which a stream of air is blown, which raises the settled sludge and discharges it into an 8 in. horizontal sludge main, which conveys it into the inlet channel, where it mixes with the incoming raw sewage and returns to the aeration tank, the excess sludge being drawn off and conveyed to sand beds for drying and disposal.

The sludge as it leaves the settling bays contains usually about 95 per cent. of water, in addition to a considerable quantity of free water, which rapidly drains away. The purified effluent is decanted from the settling tank into troughs, which convey it to the effluent channel. The total net capacity of the aeration bays affords an aeration period of six hours, with a rate of flow of one million gallons per 24 hours, plus 20 per cent. of sludge. The settling bays give a detention of one hour and forty minutes for the same rate of flow, but without the sludge.

The actual quantity treated per diem is usually 750,000 gallons, which gives 8 hours' aeration and 2¼ hours' settlement.

With these flows the conditions of the agreement in respect of the d.w.f. are complied with. Below is an analysis of the effluent.

So far as the experiment has proceeded, the requirements relating to the wet-weather flow have not been fulfilled with respect to the suspended matter, the settling area being apparently insufficient.

Analysis of Screened Sewage

(Taken May 31, 1917, Worcester Sewage Works.)

	Parts per 100,000.
Solids in suspension	10.4
Solids in solution dried at 100c	151.0
Solids in solution appearance	Brown
Solids in solution after ignition	132.0
Behavior of solids in ignition	Blackening and bad odor
Phosphates	Trace
Chlorine calculated as common salt	68.9
Free and saline ammonia	2.0
Albuminoid ammonia	0.57
Oxygen absorbed in four hours	2.1
Nitrogen in nitrates and nitrites	None
Color	Opalescent
Deposit	Dark grey
Smell	Bad

(Signed) R. Nind.

Analysis of Sewage Effluent

(Taken May 31, 1917. Worcester Sewage Works.)

	Parts per 100,000.
Solids in suspension	Trace
Solids in solution dried at 100c	143.0
Solids in solution appearance	Brown
Solids in solution after ignition	126.0
Behavior of solids in ignition	Blackening and bad odor
Phosphates	Trace
Chlorine calculated as common salt	67.7
Free and saline ammonia	2.6
Albuminoid ammonia	0.17
Oxygen absorbed in four hours	0.56
Nitrogen in nitrates and nitrites	None
Color	Slightly opalescent
Deposit	Slightly brown
Smell	Slight

Dissolved atmospheric oxygen absorbed in five days (Adeney's test)=0.63 parts per 100,000.

No putrefaction observed in five days (incubation test).

Remarks.—The above effluent is satisfactory.

(Signed) Rol. Nind.

The air compressor supplied with the plant for aeration is a double-acting reciprocating machine, designed to deliver 562 cubic feet per minute, with a speed of 235 revolutions per minute, and is driven by a 40 horsepower direct current motor.

The quantity of air delivered seemed greater than was needed; the speed of the machine was therefore reduced by increasing the diameter of the motor pulley to 150 revolutions, yielding (not counting slip) 416 cubic feet per minute with a consumption of electricity of 365 units per day. The reduction of speed doubtless diminished to some extent the efficiency of the air-compressing plant. The air is conveyed to the tank through a cast-iron main, 9 in. diameter, from which 5 in. and 4 in. branches are taken along the coping courses of the division walls. From these, wrought-iron tubes, 1 in. and 1½ in. diameter, are carried to the diffusers, which are laid upon the floors of the tank between the ridges.

The total area of the diffusers, each of which is 12 in. square, is 313 square feet, being about one-tenth of the water area, in the aeration tank.

The pressure of air at the compressor is 9 pounds per square inch; the quantity of air used is 0.8 cubic feet per gallon of sewage; the price paid for electricity is three farthings per unit; the consumption of electricity for the air supply is 488 units per million gallons; and the cost at the price paid, 30s. per million gallons treated.

Air Compressor in Duplicate

The air compressor should be in duplicate, so that the aeration may not be suspended in the event of the machine requiring repairs. Probably the most economical arrangement would be to divide the compressor plant into three units, one having a capacity equal to the maximum air required, another of 75 per cent., and the third of 50 per cent. of the maximum.

Observation of the running of the plant affords evidence that the quantity of air used is capable of oxidizing a greater quantity of sewage than the above figures indicate.

It has been said that the sludge problem is the sewage problem; that the solution of one is the settlement of the other. If that is so, then the author is of opinion that the activated sludge process is the solution of the sewage disposal problem, because, whatever fertilizing value the sludge resulting from the process may or may not possess, it is an inocuous material, and may be deposited anywhere without offence.

Fertilizing Value of Sludge

That it does possess important fertilizing properties is unquestionable, but how to apply it most economically to the land is open to much consideration. It appears to the author, so far, that after simple air drying for a few weeks in very thin layers, it could be conveyed by mechanical traction to the land, to distances which would ensure a profitable return for the expenditure, without causing the least offence. If that proves to be the case, the importance of the process will eventually be enormous from the point of view of production of food crops.

The character of the Worcester sewage is a fairly average one from the domestic and manufacturing point of view. The city is entirely water-closeted; a considerable portion of, but by no means all, the surface water is separated from the sewers, and there is a variety of manufactories, comprising breweries, porcelain works, glove works, tanneries, chrome leather works, engineering works, foundries, tinplate works, and others.

When Messrs. Jones & Attwood submitted the drawings showing the alterations they proposed to make to the tank to adapt it to the process they were going to experiment with, the author was impressed with the conviction that more energy—mechanical, chemical, and bacterial—might be obtained from the air used if, instead of allowing it to escape into the atmosphere immediately on its reaching the surface of the water, it were made to travel horizontally, carrying with it a stream of liquid for a distance, by covering the tank with a more or less airtight roof. He accordingly submitted to the firm a design for an aeration tank upon those lines, as well as a settling tank by which, he conceived, superior effects would be obtained for a given quantity of air supplied to the liquid.

(To be continued)

Convention of Ontario Municipal Association held in Toronto Aug. 29-31

THE Ontario Municipal Association held their nineteenth annual convention at the City Hall, in Toronto, on August, 29, 30, 31. Mayor Church welcomed the delegates, and in the course of a short address made special reference to the late Mr. F. S. Spence, who for many years was secretary-treasurer of the organization. The program of the convention was proceeded with, Mr. W. C. Caughell, township clerk, Yarmouth, presiding, and the reports of the executive were presented and adopted.

Among the interesting papers presented was one by City Clerk S. H. Baker, of London, on "Co-ordination of Municipal Departments," in which he dwelt on the necessity of having practical business men taking an active part in civic affairs, and recommended the civic purchasing department as a great saving in municipal expenditures. Mr. Baker also read a paper on "City Government," prepared by Mr. T. J. Moore, city clerk of Guelph, who was absent on account of illness. Other speakers were Mr. A. G. Ludlow, assessment commissioner of Brantford, whose subject was "Assessment Methods," and Mr. K. W. McKay, county clerk of Elgin, who spoke on "Changes in Assessment and Voters' Lists Acts." Hon. W. D. McPherson, chairman of the Soldiers' Aid Commission, addressed the convention in regard to the problem of caring for the returned soldiers. He gave a list of the cities and towns that were caring for returned men, and then briefly outlined the different stages in a soldier's life, from the time he was first wounded and as he passed through field dressing stations, hospitals, homes, or other institutions, until finally he was taken care of by the local authorities in his own home town. Mr. McPherson also addressed the delegates on the proposed work of the new municipal department established by the provincial government at the last session of the Legislature.

A number of important resolutions were introduced during the convention. Among them was one moved by Mr. K. W. McKay, of St. Thomas, expressing approval of the action of the House of Commons in amending the Railway Act so that no corporation or company could place poles or wires across or along streets or highways without the consent of the municipality. This was carried unanimously.

Mayor Burgoyne, of St. Catharines, moved that the government be asked, in view of the high cost of living, to increase the soldiers' pay. He also introduced a resolution to the effect that the military authorities should allow every Canadian soldier who has been at the front since the beginning of the war three months' furlough to visit Canada if the military situation permits, in view of the reinforcements expected. Other resolutions presented may be summarized as follows:

That the Ontario Government allow municipalities the revenue from liquor seized under the Ontario Temperance Act, in addition to the revenue from fines; that a tribunal be established to which the municipalities could appeal for the regulation of fire insurance rates; that legislation be applied for giving cities owning abattoirs power to control, inspect and stamp all meat which does not bear the stamp of the federal government; that income and business taxes be collected the same year that the assessment is made; that application be made for a declaratory act that the municipalities be empowered to assess the Bell Telephone Company for the use of the streets.

Mr. H. G. Kelley Succeeds Mr. Chamberlin

Mr. Howard G. Kelley, who has succeeded Mr. E. J. Chamberlin as president of the Grand Trunk Railway System and the Grand Trunk Pacific Railway, is a civil engineer by profession. He commenced his career in 1881, on the Northern Pacific Railway, as assistant engineer on location, construction, and bridge building. In 1884 he entered the mining field, but after returned to railway work, in 1887, when he became resident engineer and superintendent of bridges and highways on the St. Louis Southwestern Railway System. In 1890 he was appointed chief engineer of the system, and in 1898 consulting engineer of the same road, holding at the same time the position of chief engineer of the Iowa Central Railway. In 1907 Mr. Kelley became chief engineer of the Grand Trunk System, and four years later vice-president in charge of the operating, maintenance, and construction departments. He was elected president of the American Railway Engineering and Maintenance of Way Associations in 1905, and continued in office until March, 1907. Mr. Kelley is a member of the C.S.C.E., which he joined in 1907; he has also been a member of the council. He is a member of the Institution of Civil Engineers, London, England, and of the American Society of Civil Engineers.

The Annual Financial Review

The Annual Financial Review, published by Houston's Standard Publications, Stock Exchange Building, 84 Bay Street, Toronto, is just to hand. The Review is a carefully revised summary of facts regarding securities listed on the Montreal and Toronto stock exchanges and including many other prominent Canadian companies. It includes the current annual statements of companies; the highest and lowest prices of stocks and bonds on both exchanges for each month for ten years; the number of shares sold each month for the past fifteen months; dividends paid during the past several years, as well as other important items in the history of the different companies, such as increase in capital stock, particulars of franchises, when bonds are redeemable, dividends payable, etc., together with a mass of other facts. It comprises 700 pages of solid information, well printed, in a clear and concise manner, and nicely bound in full cloth. The work is most valuable, not only to financiers and financial institutions, but to anyone who is interested in setting aside a little pile for a rainy day or for investing safely any surplus which may not be required in his business.

Norway Building Concrete Ships

The first Norwegian iron and concrete boat was recently launched in the presence of the Prime Minister. The boat is built entirely on a new system, with the bottom up, from which position the launching took place, the underlying sledges gliding out with the ship. When the water was reached, the hull was detached from the sledges and it gradually sank to a certain point and slowly righted itself. This ship, of 200 tons, was built in three weeks, but it is stated the next can be constructed in about half that time. The frame can be used with each subsequent ship of the same size. It is the intention to start wholesale building of iron and concrete boats of from 200 to 500 to 1,000 tons.

Less than one-third of the world's 700,000 miles of railways is State owned.

Humic—A Fertilizer from Refuse

IN these days when the introduction of motor transport has so greatly reduced the output of stable manure, and, owing to the state of war, the importation of fertilizers has almost entirely ceased, any news of a new manure is sure to be welcomed by farmers and agriculturists in general as a great boon.

Captain Furse, the inventor of the system of crushing house refuse into manure by means of the patent "lightning" crusher, has now gone one better. He has discovered a process of bacterizing town refuse, thus greatly improving both the appearance and the fertilizing properties of town refuse manure.

We have been shown a sample of this new fertilizer, which the inventor has called "Humic," and which is a very fine black powder, soft to the touch, and quite odorless—that is, so far as any disagreeable odor is concerned. It has a slight, pleasant smell that at once identifies it with humus. For this is what the action of these bacteria amounts to—they actually transform the refuse into humus.

Its plant food value appears to be quite high, for a chemical analysis from the laboratory of the Agricultural College of Holmes Chapel, dated May 4 last, gives the following percentage of plant foods:

Nitrogen (about)	3	per cent.
Phosphoric acid (about)	3	per cent.
Potash (about	3¼	per cent.

Tests are being made with different crops, but a test made with a primitive sample of bacterized refuse manure has already shown an increase of over 70 per cent. in the height and bulk of oats.

We understand that the sample shown to us is by no means the limit of perfection to be attained, as both by a little more drying and certain slight modifications in the process of manufacture a much superior article can be obtained. The results already secured are, however, sufficiently satisfactory.

What gives a national importance in these days to this discovery is the practically inexhaustible supply of the crude material to be found entirely in our own country, for nothing but town refuse is used in this manure.—The Surveyor.

Model Road Exhibit

THE model road which is being exhibited by the Ontario Department of Highways at the Canadian National Exhibition is a feature which has attracted considerable attention . The exhibit is a permanent piece of roadway, 40 ft. wide and 150 ft. long, divided into several sections, which are surfaced in the most approved manner with various classes of road materials, including bituminous concrete, cement concrete, vitrified brick, water-bound macadam, gravel, and macadam treated with asphalted oil. The exhibit office is an attractive cottage by the roadside, approached by a model farm entrance over a culvert constructed according to the latest methods. Within the office a series of road models in miniature are displayed, showing in a graphic manner the various stages of road construction and forms of road material used. In addition to types of modern roads, many replicas of ancient highways are shown, including a section of an original road built of macadam and a model of the Appian Way. The present-day types of highway construction portrayed include water-bound macadam, bituminous macadam, and vitrified brick. The best method of using the log drag is also graphically illustrated, and the most efficient process of resurfacing old roads is depicted. What has been accomplished in the past several years in the construction of roads and bridges in the Province of Ontario is shown in a series of photographs.

Completion of Harbor Improvements at Singapore

May 24, 1917, saw the completion of what is regarded as the greatest enterprise ever engaged in by the Government of the Straits Settlements, namely, the reconstruction of the main wharf in Singapore harbor. The expenditure on these new harbor works from loan funds amounted to $12,568,101 on December 31, 1916, and, in addition, there has been an expenditure on works account from reserve fund of $1,296,598. These figures give an indication of the importance of the undertaking, and there is no doubt that Singapore now possesses one of the finest harbors in the world. The main wharf as reconstructed is 4,570 feet long, with a broad, straight avenue extending between the main wharf godowns and the lagoon godowns, there also being an admirable arrangement of railways linking up the whole system. The war has seriously retarded surface work, it having been found impossible to get material for the various godowns (warehouses), but when this is completed the whole will constitute an improvement worthy of the great port of Singapore.—United States Commerce Reports.

Expeditious Camp Construction Methods

In an interesting article describing the construction of Camp Upton, one of the sixteen great cantonment cities for the National Army of the United States, the Engineering News-Record describes the method of building wooden barracks. The barracks are built flat, on the finished floor, and are raised to their vertical position. The standard unit is two storeys high, and measures 140 x 43 ft. over all. The construction of the sides, as noted above, eliminates the use of scaffolding. Wooden posts are sunk in holes several feet deep, to carry the sills and floor joists, and a rough flooring is then laid. Upon this flooring the two sides of the structure are framed, and upon the studding lying flat on the floor of the building, tar paper and wooden sheathing for the sides is nailed. In other words, the sides of the building are put together complete in a horizontal position. When the wall is completed, snubbing lines are attached at intervals along the outer edge. As the wall lies flat on the flooring, workmen are lined along the inner edge every few feet, and, at a given signal, raise the wall up to a vertical position in a manner very similar to the old method of barn-raising so commonly practised in farm districts. When raised to its vertical position it is held by temporary bracing until the other side wall and the end walls can be raised into place in the same way. This scheme of construction is said to be a great time-saver, as it not only does away with the use of scaffolding but ensures more rapid work on the part of the carpenters, who are enabled to do all the framing and nailing of the siding at ground level. These buildings are being constructed by the Thompson-Starrett Company.

Owing to the high cost of materials the Central Pipe Line Company, Talbot Street, Aylmer, have decided to delay work on their pipe line from Aylmer to Springfield.

The Care of Wire Rope

The constant motion of a wire rope involves heavy strains and internal friction, and requires that the wear should be equally distributed. Intelligent lubrication will greatly prolong the working life of a wire rope, says the "Ironmonger." The initial lubrication used to lay up the hemp core around which the strands of the rope are wound is an important factor, as it should not only retard the effects of friction but also act as a preservative by minimizing internal corrosion. When a rope is properly lubricated from the inside less external lubrication is necessary, and the same lubricant should be used in both cases to obtain uniform results. The necessity for careful lubrication will be realized when it is stated that the wearing or bearing surface of 100 feet of 1 inch diameter wire rope is about 334 square feet, whereas the bearing surface in a 35,000 horse-power reversing engine, one of the largest in the world, is 319 square feet.

Mineral Production of Canada for the Calendar Year 1916

A preliminary report on the mineral production of Canada for the calendar year 1916 has been issued by the Department of Mines. In a general way it may be said that Canada's mineral production for the year has increased, though two or three decreases are shown, one of the most marked of which is stone, about 9 per cent.; also sand and gravel, about 8 per cent., and cement, about 6½ per cent., thus indicating the slack condition of the building trades. Pig iron, lead, and silver also show a decrease in quantities, but, with the exception of pig iron, an increase in value, owing to improved market conditions. The following general information will be of interest to the building trades:

Iron Ore

Iron ore mining operations have been confined to the Helen and Magpie mines of the Algoma Steel Corporation, in the Michipicoten District of Ontario, together with a small production of ilmenite at Ivry-on-the-Lake, Quebec, by the Manitou Iron Mining Company. There was also a shipment of concentrates from the concentrator at Trenton, Ont., produced in previous years from ores derived from the Bessemer and Childs mines in Hastings County. The total shipments in 1916 were 339,600 short tons, valued at $814,044, as compared with 398,112 tons, valued at $774,427, shipped in 1915. The 1916 shipment included 109,965 tons of Helen ore, part of which was sent to Magpie for roasting, 210,522 tons of roasted siderite from Magpie, 15,904 tons of magnetite concentrates, and 3,209 tons of ilmenite. The shipments in 1915 included 205,989 tons of hematite, 132,906 tons of roasted siderite, and 59,217 tons of magnetite (including some ores with an admixture of hematite). In the Great Lakes area the ore prices for 1916 were: Old Range Bessemer, $4.45 per gross ton; Messabi Bessemer, $4.20; Old Range Non-Bessemer, $3.70, and Messabi-Non-Bessemer, $3.55, an increase of 70 cents over 1915 prices. The 1917 quotations already fixed are $1.50 in advance of those of 1916.

Mine operators reported 140,608 tons of ore exported to the United States and 198,992 tons shipped to Canadian furnaces. According to the records of the Customs Department, exports of iron ore amounted to 161,260 tons, valued at $541,779, and imports of iron ore to 2,339,667 tons, valued at $4,419,013. Shipments of iron ore from Wabana Mines, Newfoundland, in 1916 by the two Canadian companies operating there were 1,012,060 short tons, all of which were shipped to Cape Breton. In 1915 the total shipments were 868,451 short tons, of which 802,128 tons were shipped to Cape Breton and 66,323 tons to England.

Pig Iron

The total production of pig iron in 1916, not including the output of ferro-alloys, was, according to complete returns now received, 1,169,257 short tons (1,043,979 long tons), valued at $16,750,903, as compared with 913,775 short tons (815,870 long tons), valued at $11,374,199, in 1915, showing an increase of 255,482 tons, or 27.9 per cent. The 1916 production was greater than that of any previous year, the second largest production of pig iron having been 1,128,967 short tons in 1913. The production in Nova Scotia in 1916 was 470.055 tons, as against 420,275 tons in 1915, an increase of 49,780 tons, or 11.8 per cent., while the production in Ontario was 699,202 tons in 1916, compared with 493,500 tons in 1915, an increase of 205,702 tons, or 41.7 per cent. Of the total output in 1916, 17,304 tons were made with charcoal as fuel, as against 13,692 tons made with charcoal in 1915. By grades the 1916 production included: Basic, 953,627 tons; Bessemer, 31,388 tons; foundry and malleable, etc., 184,242 tons. The 1915 production included: Basic, 739,613 tons Bessemer, 29,052; foundry and malleable, etc., 145,110 tons.

The blast furnace plants operated were the same as in the previous years, viz.: the Dominion Iron and Steel Company, at Sydney, N.S.; the Nova Scotia Steel and Coal Company, at North Sydney; the Standard Iron Company, at Deseronto, Ont.; the Steel Company of Canada, at Hamilton, Ont.; the Canadian Furnace Company, at Port Colborne, Ont., and the Algoma Steel Corporation, at Sault Ste. Marie, Ont. The production of ferro-alloys in Canada in 1916, chiefly ferro-silicon, but including also ferro-phosphorus and ferro-molybdenum, all made in electric furnaces, was 28,628 tons, valued at 1,777,615, as compared with a production in 1915 of 10,794 tons, valued at $753,404. The exports during 1916 of pig iron were 23,304 tons, valued at $374,383, or an average per ton of $16.07, and of ferro-silicon and ferro-compounds 22,802 tons, valued at $1,352,013, or an average of $59.29 per ton. The imports during 1916 included 57,337 tons of pig iron, valued at $1,128,557, or an average of $19.68 per ton; 793 tons of charcoal pig, valued at $16,593, or an average of $20.92, and 45,309 tons of ferro products, valued at $1,879,448, or an average of $41.48 per ton, making a total import of pig iron and ferro-alloys of 103,439 tons, valued at $3,024,598.

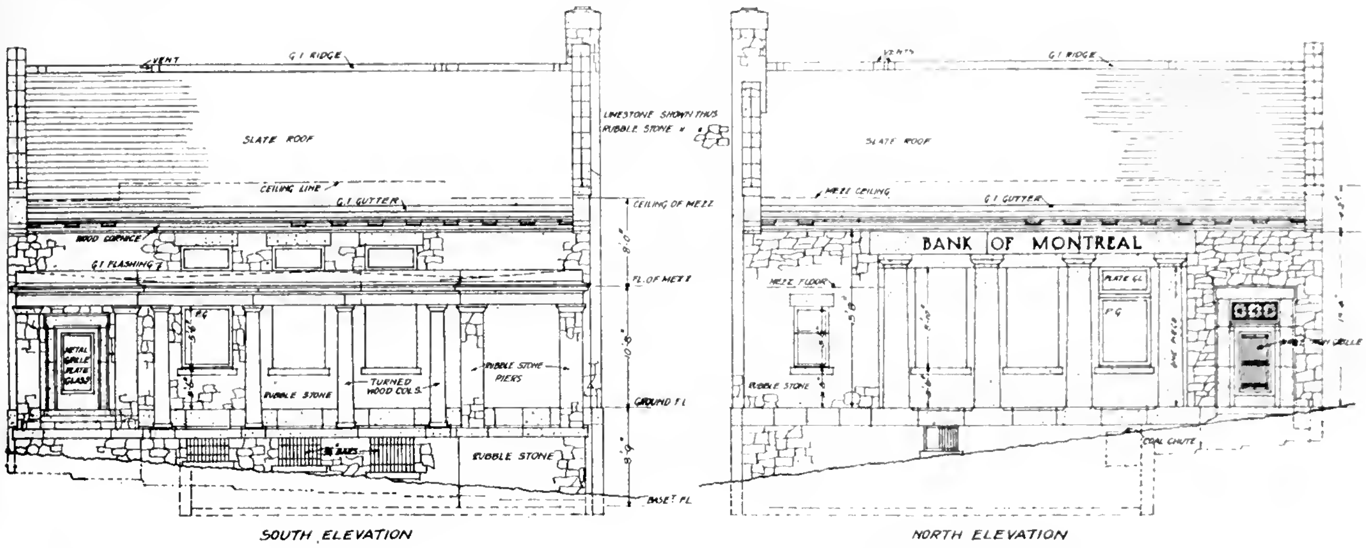
Steel Ingots and Castings

The estimated production of steel ingots and castings in 1916, as published at the end of December (complete returns have not yet been received), was 1,454,124 short tons (1,298,325 gross tons), of which 1,423,485 short tons were ingots and 30,639 tons direct steel castings. The total production in 1915 was 1,020,896 short tons, showing an increase in 1916 of

Increase or Decrease in Principal Products, 1916

Principal Products.		Increase (+) or Decrease (−) in Quantity.	%	Increase (+) or Decrease (−) in Value.	%
Copper	Lbs.	+18,985,664	18·84	+15,169,422	87·13
Gold	Ozs.	+ 8,907	0·97	+ 184,134	0·97
Pig iron from Canadiao Ore (a)	Tons.	− 42,904	27·05	− 387,279	23·57
Lead	Lbs.	− 4,723,770	10·20	+ 947,149	36·52
Nickel	"	+14,849·907	31·45	+ 8,542,900	41·69
Silver	Ozs.	− 956,768	3·59	+ 3,623,793	27·41
Total metallic		....	......	+31,325,194	41·19
Asbestos and Asbestic	Tons.	+ 17,674	12·91	+ 1,585,494	44·35
Coal	"	+ 1,194,655	9·00	+ 6,746,375	21·01
Gypsum	"	− 133,197	28·05	− 134,098	14·52
Graphite	"	+ 1,336	50·70	+ 161,139	129·71
Magnesite	"	+ 40,634	374·94	+ 437,245	345·40
Natural gas	M. ft.	+ 5,114,406	25·41	+ 216,997	5·86
Petroleum	Brls.	− 17,341	8·05	+ 91,712	50·51
Pyrites	Tons.	+ 23,373	8·17	+ 98,829	10·03
Quartz	"	+ 8,695	6·84	+ 36,653	17·87
Salt	"	+ 4,133	3·45	+ 68,401	11·40
Cement	Brls.	− 321,982	5·67	− 447,163	6·41
Clay products		....	......	+ 282,445	7·22
Lime	Bush.	+ 435,632	8·63	+ 73,803	7·38
Sand and Gravel		....	......	− 126,758	7·80
Stone		....	......	− 376,938	8·88
Total non-metallic		....	......	+ 9,023,089	14·72
Grand total		....	......	+40,348,283	29·35

(a) The total production of pig iron shows an increase.



North and south elevations new building for the Bank of Montreal, Grand'Mere, Quebec.

433,228 tons, or over 42 per cent. The 1916 production was greater than that of any previous year, the second largest production having been 1,168,993 short tons in 1913. Of the total production of steel ingots and castings in 1916, about 43,790 short tons (39,098 gross tons) were made in electric furnaces. In 1915 only 61 short tons were reported as having been made in electric furnaces.

New Bank Building at Grand'Mere

Messrs. Gray & Dunn, Montreal, are constructing for the Bank of Montreal a branch office at Grand'Mere, Que., from plans by Mr. G. Kenneth Rea, F.R.I.B.A., Montreal. The building consists of one story, a mezzanine floor, and a basement, on a site 51 x 44, with the office on the ground floor and a clerk's residence on the mezzanine floor. At the east end there is a gable roof. The foundations are of rock, excavated to a depth of six feet. The exterior is of Scotch masonry, the front or north elevation showing four columns of Montreal limestone between the windows (fitted with plate glass and pivoted sash). Just above the heads of the columns the words "Bank of Montreal" in raised bronze letters are placed. The entrance door has a wrought iron grille.

The basement is designed for a book vault, with cement floor, lavatory, men's coat room, storage, furnace room, and coal space. On the ground floor the entrance leads to a vestibule, and from there into a large space for the public. This has a tiled floor and a coved burlap dado. Behind the counter, extending along the front and on one side, is accommodation for the accountant, ledger clerks, tellers, and also the working desks. The manager's office, 12 ft. 7 in. x 15 ft. 8 in., is at the right side. It has a floor of birch and a burlap dado. A specie vault is placed at the rear; the floor is of tile and the base walls and ceiling of plaster. A vestibule leads to a loggia, paved with flagstones, on the south side. Here the exterior is of the same construction as on the north elevation, except that the columns are seven instead of four, the three centre ones being of turned wood and the others of rubble stone. The roof is of slate, with galvanized iron gutter and flashing.

On the mezzanine floor are living and bedrooms, access being obtained from the ground floor by a stairway fitted with wood treads and risers.

It is understood that the centre span of the Quebec bridge will not be hoisted before the end of September. The date of this event has been deferred, it is said, owing to delay in delivery of certain materials.

Mainly Constructional

East and West—From Coast to Coast

The Midland Shipbuilding Company has been incorporated, with a capital of $1,000,000; headquarters at Midland.

The city of Outremont, P.Q., has decided to postpone the building of an incinerator, for which bids were received, until next spring.

Satisfactory progress is being made on the erection of the steel superstructure of the new bridge over the Petitcodiac River at Moncton, N.B.

The directors of the Reade Construction Company, Ltd., have decided to change the location of their head office from Toronto to Montreal. This action has been approved by the shareholders.

According to the statement of Hon. C. J. Doherty, Minister of Justice, Thomas Kelly, the Winnipeg contractor, was released from Stoney Mountain Penetentiary to a public hospital because he was in a failing condition and in actual danger of death.

Several breaks have been discovered by a diver in the intake pipe of the waterworks plant of Petrolia, Ont., at Perch, on the lake shore. The pipe, which runs about 1,000 feet out into the lake, is 12 inches in diameter, and the water flows by gravitation into the well at the plant.

According to a recent announcement, the Ontario Government proposes to take over the entire portion of the Kingston Road, between Toronto and Port Hope, and will begin work immediately on the repair of certain bridges and the grading of parts of the road which are said to be in a dangerous condition.

An international drainage convention is to be held at Creston, B.C., on September 29. This follows one held at Bonner's Ferry, Ida., in the early part of August. It is proposed to request the presence of the Minister of Lands, the Minister of Works, the Comptroller of Water Rights, and other government officials at Victoria who are conversant with the work.

The embargo on stone cars by the G.T.R., which has been holding up the work on the Toronto-Hamilton Highway, has been lifted, a consignment of five 50-ton loads having been received from the Dundas quarries. Work on the highway has been recommenced, and the railway company have promised to do everything possible to hurry up shipments in future.

The Atlas Construction Company are behind a scheme for the construction of reinforced concrete vessels in Montreal. The first is to be constructed in the Mill Street drydock, and will be 125 feet long. It is understood that the cost will be within $100,000, and the vessels is expected to be launched by October. Prominent Montreal business men will provide the capital.

The Graham Development and Contracting Company, Ltd., is the name of a new concern which has just been incorporated, with a capital of $100,000, having its head office at Fort William, Ont. It has been organized for the purpose of carrying on a general lumbering, contracting, mining, farming, and prospecting business, and is authorized to do all kinds of construction work.

At a recent meeting of the Southampton Board of Trade, which was attended by several members of the Guelph Board of Trade, the question of putting the road leading from Guelph to Southampton in good shape for tourist travel was discussed. The proposal was received with favor, and it was suggested that this be made an extension of the proposed highway from Hamilton to Guelph.

There are various reports in regard to the plans of the Curtis & Harvey Company in regard to the reconstruction of their trinitrotol plant at Dragon, Que., recently destroyed by explosion. Mr. T. H. Curtis, vice-president and managing director, has announced that the company will not rebuild on the same scale, but it is not definitely stated whether they will reestablish their plant at all or not.

All the concrete piers for the new bridge over the Mississippi River on the Lanark-Perth road, in the County of Lanark, Ont., are completed and the steel gang are now engaged in stringing the steel superstructure. The approaches are also well advanced, and it is expected the structure will be ready for traffic within a few weeks. One advantage resulting from the erection of the new bridge is the elimination of a rather heavy grade at the south end.

A new school is nearly completed in Port Credit, Ont., on Forest Avenue. This is a two-storey brick building, and its cost, including the site, is about $30,000. The interior walls are of interlocking tile, while all the stairs are of steel and stone. There are four rooms, each with a seating capacity of 60 pupils. The two rooms on the upper floor are connected by folding doors, which allows the floor to be turned into a hall. The basement, which is entirely cemented, is to be used by the children as a playroom. The interior is finished in Georgia pine, with maple floors.

A recommendation has been submitted to the administration board of the Greater Winnipeg Water District, signed by W. G. Chace, chief engineer for the district, and James H. Fuertes, consulting engineer, to the effect that the pipe line from the westerly shaft of the Red River tunnel to the McPhillips Street reservoir be built of reinforced concrete, 48 in. internal diameter, instead of laying a cast iron pipe, as originally intended. This recommendation is mainly due to the greatly increased cost of cast iron pipe. The engineers state their belief that the entire line can be built of reinforced concrete for about $400,000, while at present prices they estimate the cost of the cast iron pipe line, laid in the trench, at $575,000.

At a recent meeting of the Town Council of Battleford, Sask., Mr. V. T. Robinson, sanitary engineer, reported that the operations previously authorized in connection with sewage disposal had been carried out, and that the crude sludge had been stopped from going into the river. The hole in the bottom of the intersecting chamber had been repaired so that it could be raked out at intervals. He suggested that a siphon from the septic tank would relieve the situation and the necessity of pumping out the tank so often, as by this means the top two feet of the contents could be removed and spread on the undamaged portion of the filter beds. It was also recommended that the old dam should be removed as soon as possible. The waterworks committee was instructed to carry out Mr. Robinson's suggestions.

Personals

Mr. Omer Arnold has been appointed engineer for the Townships of Bastard and Burgess (South), Ont.

Professor J. C. McLennan, director of the physical laboratory of the University of Toronto, has been gazetted an officer of the Order of the British Empire.

Mr. B. L. Eastman, mining engineer, who has been at the Bluebell Mine, in British Columbia, for some years, has left for the United States, to offer himself for overseas service.

Mr. Arthur J. Farnsworth has been engaged by the Taylor Engineering Company, of Vancouver, to conduct a research department in connection with the operations of the firm.

Mr. W. E. Gillen, general superintendent of the Grand Trunk Railway at Chicago, has been promoted to the position of vice-president and traffic manager, with headquarters at Montreal.

Messrs. R. M. Halfpenny and W. Jackson have retired from their respective positions with the Edmonton, Dunvegan, and British Columbia Railway as superintendent and chief engineer.

Mr. W. D. Robb, who has been superintendent of motive power of the G.T.R., has been appointed vice-president, with control of the locomotive power department, car department, and of all shops.

Mr. R. B. Bennetts, of Tacoma, has been appointed consulting engineer for the Ladysmith Smelting Corporation. He will supervise the installation of a copper converter plant at Ladysmith, B.C.

Mr. George C. Jones, formerly general manager of the Central Vermont Railway, with headquarters at St. Albans, N.Y., has now been appointed assistant to the president of the G.T.R., with headquarters at Toronto.

Private Alan W. Groves, who prior to his enlistment was a student at the Faculty of Applied Science and Engineering of the University of Toronto, is mentioned in a recent casualty list as suffering from gas poisoning. He went overseas in September, 1915, and was wounded on September 15, 1916, on which date he was erroneously reported killed.

Lieut. Frank Steers, son of Mr. C. J. Steers, of the Department of the Interior, Ottawa, is reported wounded in recent fighting. Lieut. Steers went overseas last fall having received a commission in the Canadian Engineers' Training Depot at St. John's, P.Q. He was educated at Toronto University, but before being graduated left for the Canadian Northwest to do surveying for the Dominion Government. Latterly he was in the employ of the Department of the Interior, in Ottawa.

Obituary

Mr. J. W. N. Watts, R.C.A., honorary treasurer of the Royal Architectural Institute of Canada since its foundation, ten years ago, died suddenly on Sunday, the 26th of August, 1917, at his home, Ottawa.

Mr. Alexander Mitchell, formerly one of Toronto's well-known building contractors, recently passed away. The late Mr. Mitchell was born in Barrie, Ont., in 1839, and came to Toronto about fifty years ago. Ten years ago he retired from business.

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Principal Contents

Freight Car Saving

ON several occasions the Contract Record has pointed out that the shortage of freight cars on the railroads has been largely augmented by the inefficient methods of loading practised by many shippers. The railway companies have pointed out that by filling cars to a greater capacity, the shortage will be very largely overcome. To illustrate the significance of this, the Railroads' War Board of the United States has just issued a statement which shows that during the month of July its efforts to load cars in such a way as to eliminate waste space, resulted in a saving equivalent to 120,000 cars. The Railroads' War Board aims to co-ordinate the railroads with shippers, regulating bodies, and the public generally. This co-operation has made possible the intensive loading of freight cars and prompter unloading, the elimination of a large amount of unnecessary passenger train service and an opportunity generally to use the railroad plant efficiently. Their co-operative efforts are thus directed to giving to the country the greatest possible amount of freight service at a time when government and commercial traffic has increased to an extraordinary degree. The report of this board shows that the excess of unfilled car requisitions over idle cars—termed the car shortage—was only one-fourth as great on August 1, 1917, as on May 1, 1917. The excess of unfilled car requisitions on May 1 was 148,627, and on August 1 it had been reduced to 33,776.

With the approach of harvest, further efforts are being made to relieve the car situation, and the Board is emphasizing the following suggestions to shippers:

Unload promptly all loaded cars received.

Load promptly all outgoing cars and release them immediately to the railroad.

Anticipate disposition of freight before its arrival.

Do not order special types of cars when ordinary types will serve.

Eliminate use of railway equipment when tonnage can be handled by motor trucks or wagon.

Load all cars to their full carrying capacity.

It is pointed out that there are six ways in which the loading of cars to their full carrying capacity can be achieved, and enumerates them as follows:

More careful supervision of loading.

Producers and buyers agreeing to disregard established trade units and increase the units as a war measure.

Waiving rights in regard to minimum weights under tariff and traffic regulations.

Buyers increasing their orders so as to fill the car, and producers disposing of their output on a basis of full carrying capacity of equipment furnished.

Buyers who cannot handle larger quantities clubbing together with other buyers to make full capacity cars.

Showing customers who desire, merely as a matter of convenience, smaller units than maximum, how they can help the general situation by enduring inconvenience.

Not Recognized

THE "Builder," our English contemporary, deplores the fact that the government has not seen fit to make extensive use of the technical and trade press to appeal to men in particular trades or professions directly reached by class organs. The daily newspapers have been used to obtain the help of business and commercial men who might be appealed to perhaps more effectively through the trade or professional journal. The governments of Canada are no less culpable in this regard, and the comments in the "Builder" are passed on to indicate wherein improvement might be shown:

At a time like the present, when all the resources of the country, including the efforts of private enterprise, are needed to win the war, it is somewhat surprising that the Government has not made more use of the technical and trade press of the country. It might have been supposed that when the help of men following a particular trade or profession was required the Government would certainly have appealed to them through the journals which directly reach and are read by them; while in the use of notifications directly or indirectly affecting certain trades there is no apparent reason why the daily press should be considered the have promised to do everything possible to hurry up shipments in future.

The Atlas Construction Company are behind a scheme for the construction of reinforced concrete vessels in Montreal. The first is to be constructed in the Mill Street drydock, and will be 125 feet long. It is understood that the cost will be within $100,000, and the vessels is expected to be launched by October. Prominent Montreal business men will provide the capital.

The Graham Development and Contracting Company, Ltd., is the name of a new concern which has just been incorporated, with a capital of $100,000, having its head office at Fort William, Ont. It has been organized for the purpose of carrying on a general lumbering, contracting, mining, farming, and prospecting business, and is authorized to do all kinds of construction work.

At a recent meeting of the Southampton Board of Trade, which was attended by several members of the Guelph Board of Trade, the question of putting the road leading from Guelph to Southampton in good shape for tourist travel was discussed. The proposal was received with favor, and it was suggested that this be made an extension of the proposed highway from Hamilton to Guelph.

There are various reports in regard to the plans of the Curtis & Harvey Company in regard to the reconstruction of their trinitrotol plant at Dragon, Que., recently destroyed by explosion. Mr. T. H. Curtis, vice-president and managing director, has announced that the company will not rebuild on the same scale, but it is not definitely stated whether they will reestablish their plant at all or not.

All the concrete piers for the new bridge over the Mississippi River on the Lanark-Perth road, in the County of Lanark, Ont., are completed and the steel gang are now engaged in stringing the steel superstructure. The approaches are also well advanced, and it is expected the structure will be ready for traffic within a few weeks. One advantage resulting from the erection of the new bridge is the elimination of a rather heavy grade at the south end.

A new school is nearly completed in Port Credit, Ont., on Forest Avenue. This is a two-storey brick building, and its cost, including the site, is about $30,000. The interior walls are of interlocking tile, while all the stairs are of steel and stone. There are four rooms, each with a seating capacity of 60 pupils. The two rooms on the upper floor are connected by folding doors, which allows the floor to be turned into a hall. The basement, which is entirely cemented, is to be used by the children as a playroom. The interior is finished in Georgia pine, with maple floors.

A recommendation has been submitted to the administration board of the Greater Winnipeg Water District, signed by W. G. Chace, chief engineer for the district, and James H. Fuertes, consulting engineer, to the effect that the pipe line from the westerly shaft of the Red River tunnel to the McPhillips Street reservoir be built of reinforced concrete, 48 in. internal diameter, instead of laying a cast iron pipe, as originally intended. This recommendation is mainly due to the greatly increased cost of cast iron pipe. The engineers state their belief that the entire line can be built of reinforced concrete for about $400,000, while at present prices they estimate the cost of the cast iron pipe line, laid in the trench, at $575,000.

At a recent meeting of the Town Council of Battleford, Sask., Mr. V. T. Robinson, sanitary engineer, reported that the operations previously authorized in connection with sewage disposal had been carried out, and that the crude sludge had been stopped from going into the river. The hole in the bottom of the intersecting chamber had been repaired so that it could be raked out at intervals. He suggested that a siphon from the septic tank would relieve the situation and the necessity of pumping out the tank so often, as by this means the top two feet of the contents could be removed and spread on the undamaged portion of the filter beds. It was also recommended that the old dam should be removed as soon as possible. The waterworks committee was instructed to carry out Mr. Robinson's suggestions.

Personals

Mr. Omer Arnold has been appointed engineer for the Townships of Bastard and Burgess (South), Ont.

Professor J. C. McLennan, director of the physical laboratory of the University of Toronto, has been gazetted an officer of the Order of the British Empire.

Mr. B. L. Eastman, mining engineer, who has been at the Bluebell Mine, in British Columbia, for some years, has left for the United States, to offer himself for overseas service.

Mr. Arthur J. Farnsworth has been engaged by the Taylor Engineering Company, of Vancouver, to conduct a research department in connection with the operations of the firm.

Mr. W. E. Gillen, general superintendent of the Grand Trunk Railway at Chicago, has been promoted to the position of vice-president and traffic manager, with headquarters at Montreal.

Messrs. R. M. Halfpenny and W. Jackson have retired from their respective positions with the Edmonton, Dunvegan, and British Columbia Railway as superintendent and chief engineer.

Mr. W. D. Robb, who has been superintendent of motive power of the G.T.R., has been appointed vice-president, with control of the locomotive power department, car department, and of all shops.

Mr. R. B. Bennetts, of Tacoma, has been appointed consulting engineer for the Ladysmith Smelting Corporation. He will supervise the installation of a copper converter plant at Ladysmith, B.C.

Mr. George C. Jones, formerly general manager of the Central Vermont Railway, with headquarters at St. Albans, N.Y., has now been appointed assistant to the president of the G.T.R., with headquarters at Toronto.

Private Alan W. Groves, who prior to his enlistment was a student at the Faculty of Applied Science and Engineering of the University of Toronto, is mentioned in a recent casualty list as suffering from gas poisoning. He went overseas in September, 1915, and was wounded on September 15, 1916, on which date he was erroneously reported killed.

Lieut. Frank Steers, son of Mr. C. J. Steers, of the Department of the Interior, Ottawa, is reported wounded in recent fighting. Lieut. Steers went overseas last fall having received a commission in the Canadian Engineers' Training Depot at St. John's, P.Q. He was educated at Toronto University, but before being graduated left for the Canadian Northwest to do surveying for the Dominion Government. Latterly he was in the employ of the Department of the Interior, in Ottawa.

Obituary

Mr. J. W. N. Watts, R.C.A., honorary treasurer of the Royal Architectural Institute of Canada since its foundation, ten years ago, died suddenly on Sunday, the 26th of August, 1917, at his home, Ottawa.

Mr. Alexander Mitchell, formerly one of Toronto's well-known building contractors, recently passed away. The late Mr. Mitchell was born in Barrie, Ont., in 1839, and came to Toronto about fifty years ago. Ten years ago he retired from business.

ESTABLISHED 1886

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Vol. 31 **September 12, 1917** **No. 37**

Principal Contents

Freight Car Saving

ON several occasions the Contract Record has pointed out that the shortage of freight cars on the railroads has been largely augmented by the inefficient methods of loading practised by many shippers. The railway companies have pointed out that by filling cars to a greater capacity, the shortage will be very largely overcome. To illustrate the significance of this, the Railroads' War Board of the United States has just issued a statement which shows that during the month of July its efforts to load cars in such a way as to eliminate waste space, resulted in a saving equivalent to 120,000 cars. The Railroads' War Board aims to co-ordinate the railroads with shippers, regulating bodies, and the public generally. This co-operation has made possible the intensive loading of freight cars and prompter unloading, the elimination of a large amount of unnecessary passenger train service and an opportunity generally to use the railroad plant efficiently. Their co-operative efforts are thus directed to giving to the country the greatest possible amount of freight service at a time when government and commercial traffic has increased to an extraordinary degree. The report of this board shows that the excess of unfilled car requisitions over idle cars—termed the car shortage—was only one-fourth as great on August 1, 1917, as on May 1, 1917. The excess of unfilled car requisitions on May 1 was 148,627, and on August 1 it had been reduced to 33,776.

With the approach of harvest, further efforts are being made to relieve the car situation, and the Board is emphasizing the following suggestions to shippers:

Unload promptly all loaded cars received.

Load promptly all outgoing cars and release them immediately to the railroad.

Anticipate disposition of freight before its arrival.

Do not order special types of cars when ordinary types will serve.

Eliminate use of railway equipment when tonnage can be handled by motor trucks or wagon.

Load all cars to their full carrying capacity.

It is pointed out that there are six ways in which the loading of cars to their full carrying capacity can be achieved, and enumerates them as follows:

More careful supervision of loading.

Producers and buyers agreeing to disregard established trade units and increase the units as a war measure.

Waiving rights in regard to minimum weights under tariff and traffic regulations.

Buyers increasing their orders so as to fill the car, and producers disposing of their output on a basis of full carrying capacity of equipment furnished.

Buyers who cannot handle larger quantities clubbing together with other buyers to make full capacity cars.

Showing customers who desire, merely as a matter of convenience, smaller units than maximum, how they can help the general situation by enduring inconvenience.

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What Will be the Effect of the U.S. Steel Embargo?

THERE is some uncertainty as to what effect the order from Washington declaring an embargo on steel products, will have on the Canadian trade. It is stated that if the embargo extends to the trade between the two countries, much inconvenience will result. It will not, of course, affect the steel trade as a whole, but more particularly those Canadian firms which are more or less dependent on the United States industries for all kinds of structural shapes. There is also uncertainty as to the price policy which the United States Government may finally adopt, relative to its purchase of raw materials. Much steel is being taken for war work, but in most cases the price named is only a tentative figure pending the establishment of a definite price when the Federal Trade Commission has fixed production costs. It is not known by the producers of iron and steel how much of their output will be required by the government, and there is also the question of the effect the entrance into the war may have on the prices of fuel, labor and raw materials.

Commercializing Coal Impurities

IN many bituminous coal mines the mineral impurity, pyrite, occurs with the coal The amount of this impurity varies from 1 to 10 per cent. of the coal as mined.

Pyrite is one of the sources from which sulphuric acid is obtained, and sulphuric acid is used extensively in the manufacture of explosives and fertilizers. Normally the demand for pyrite has been easily and cheaply met by importations of pyrite from Spain, and the market for domestic pyrite is not regarded as sufficiently large to justify its recovery in coal mining operations. It is, therefore, discarded as useless.

Under present conditions, the supply of Spanish pyrite has been cut off owing to the high cost of ocean transportation, while the demand has increased. The market is active, and prices as high as $8 per ton are offered.

The engineering experiment station of the University of Illinois has just completed a series of experiments, conducted on a commercial scale under the direction of Professor E. A. Holbrook of the department of Mining Engineering, to develop a simple process for the economic recovery of pyrite occurring with bituminous coal. As a result of these experiments, it has been possible to prepare estimates which indicate that a 50-ton per day plant, costing approximately $18,000, may be designed which will yield a profit under present conditions of $75 per day, or $1.50 per ton of raw pyrite. The possible commercial use of these results at the present time by the coal mining industry is suggested.

A recently issued bulletin, No. 51, incorporates the results of the tests and suggestions for the application of the processes.

Engineers Have Summer Meeting

THE first annual summer meeting of the Saskatchewan Branch of the Canadian Society of Civil Engineers was held in Moose Jaw on Saturday, August 18. The delegates were taken in charge by City Engineer Geo. D. Mackie and Assistant Engineer W. H. Greene, during a tour of the various industries of the city. During the evening they were guests of the city at a dinner in the Royal George Hotel, at which Acting Mayor Geo. C. Ingram presided. Brief addresses were given by Commissioner Thornton, Regina; Alderman McIntyre, of Moose Jaw, and Fraser S. Keith, general secretary of the Canadian Society of Civil Engineers.

It has been decided to hold the next summer meeting of the Society in August of 1918, at Saskatoon, where all the members of the western branches of the Society will be invited to attend. Other business transacted was the nomination of executive and other committees for the ensuing year. Mr. Geo. D. Mackie received the unanimous nomination for chairman. Among the members present were H. S. Carpenter, L. A. Thornton, D. A. R. McCannell, Lieut.-Col. McVean, W. D. Huston, J. R. C. McCreadie, division engineer of the C. P. R.; C. S. Morse, resident engineer of the C. P. R., Moose Jaw; Lieut. R. J. Lecky, Military District No. 12; W. H. Begg, C. P. Richards, H. R. MacKenzie, Saskatchewan Highways Department; M. Sinclair, chief munitions inspector, Moose Jaw; J. Carmichael, architect of the Military Hospitals Commission; G. D. Mackie, W. H. Greene, J. N. de Stein, secretary of the Saskatchewan Branch of the Society.

Edmonton Utilities Doing Well

Mr. A. G. Harrison, city commissioner of Edmonton, Alta., submits the following report showing the surplus made by the various utilities of that city over and above operation and maintenance, for the six months ending June 30, 1917. The results gained by civic management of Edmonton's utilities appear to be very gratifying:

Department.	Surplus over operation and maintenance.
Electric light and power	$143,151.89
Telephone	92,165.20
Waterworks	87,732.00
Street railway	42,488.04
Total	$365,537.13

Fifty-foot Reinforced Concrete Trussed Girders in Toronto Office Building

Five Trusses, Said to be Largest on Continent, Carry Load of Ten Stories—Exclusion of Limestone Increases Fire Resistance

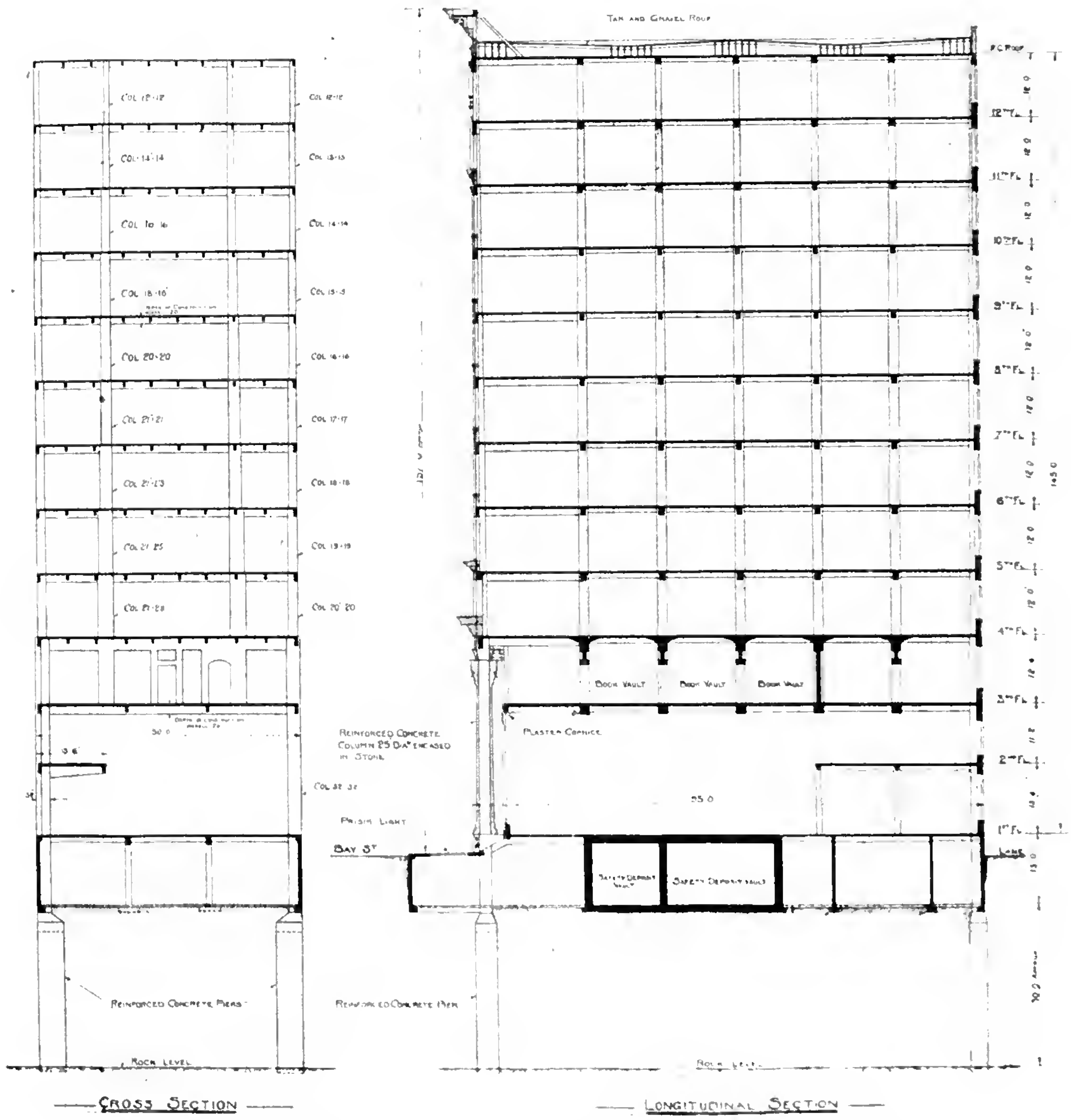
THE Trusts & Guarantee Company have now entered into occupation of their new home at 120 Bay Street, Toronto. The frontage on Bay Street is 50 feet and the building extends back for a depth of 95 feet. The building is designed to have twelve storeys, but has been for the present stopped at the seventh floor.

Several interesting features enter into the construction of this building. The greatest care has been taken to render the building absolutely fireproof. Not only is the entire structure of reinforced concrete, but the concrete itself is of greater fire resisting qualities than probably any other building in the city. This result has been obtained by excluding from the concrete any limestone, which is the material most generally used on concrete structures of this nature in the city. Limestone disintegrates under the action of great heat and water.

Hennebique System

The building is of reinforced concrete constructed on what is known as the Hennebique system of ferro-concrete. It is the first building constructed on this system in Toronto. The steel bars used to reinforce the concrete are ordinary commercial shapes purchased in the open market. These are used liberally and spaced in such a way as to equalize to the greatest possible extent, at all temperatures, the strains and stresses involved in a building of this nature.

The building is, in effect, a complete reinforced-



Sections of Trust and Guarantee Building, showing location of the five concrete girders above main floor. The building wil ultimately be 12 stories in height; seven floors have now been completed.

concrete frame structure, having the exterior and interior walls carried to each floor level by reinforced concrete columns and beams. The column foundations are carried to solid rock. The general plan of the building will be understood from the illustrations in Fig. 1, which reproduces a cross section and also a longitudinal section.

The main feature of the building is the large general office on the main floor. This occupies the whole width 50 feet and depth 90 feet of the building and is 24 ft. 6 ins. high. It is entirely free of columns, excepting under the rear portion of the mezzanine gallery. The roof of the chamber and the floors above are carried on five reinforced concrete girders 50 feet span and having a depth of 14 feet 6 inches. These girders extend from the second to the third floor and form the partitions on the second floor, the centre portion of which is mainly for the vaults of the Trusts and Guarantee Company, the offices being situated at the front and rear.

Largest Concrete Girder on Continent

So far as is known, these are the largest concrete girders on the American continent, with the exception of a 66 ft. span truss under construction at the new Masonic Temple. Their construction is particularly interesting. The clear span is 45 ft. 8 ins., and the concentrated loads from the two columns supporting the upper floors which these trusses carry, as shown, vary from 194 to 250 tons in addition to the load of the second and third floors.

There are five of these trusses, and, as the depth of each is 14 ft. 6 ins., it will be seen that they act as walls, partitioning the second floor into approximately six equal compartments. To provide access from one compartment to another, openings have been provided through these trusses.

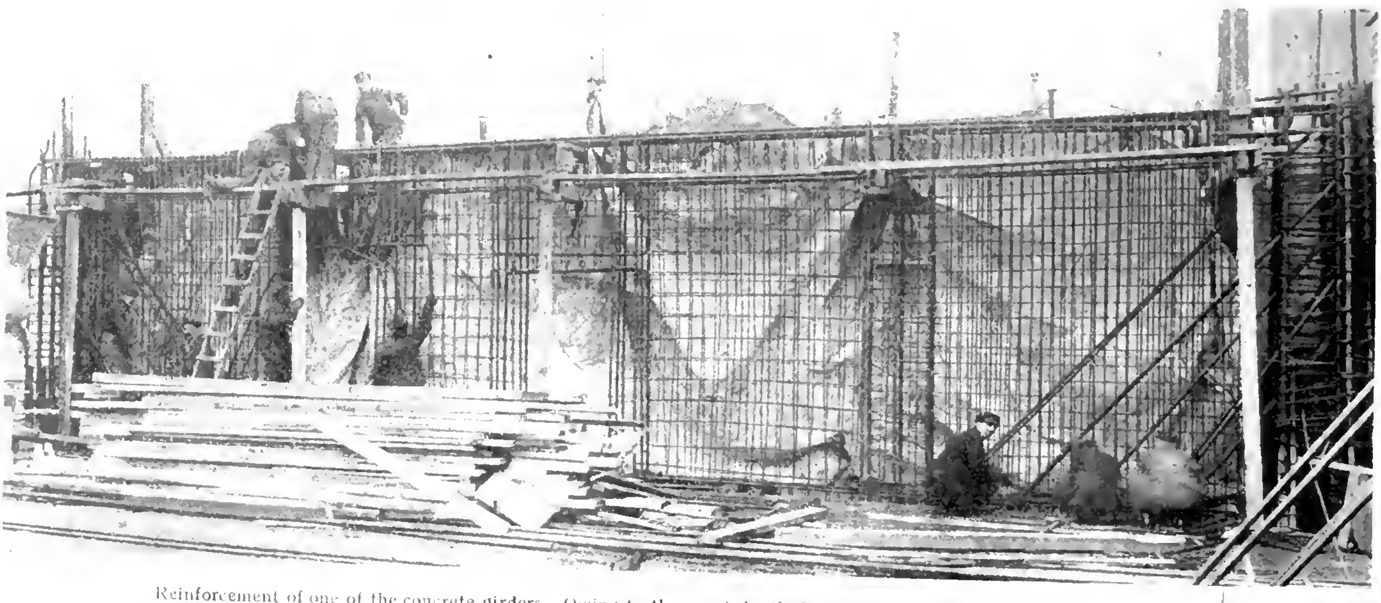
One of the views herewith shows the reinforcement of one of these trusses in place before the form work is erected. The steel is first placed, as shown, and then the lower member is poured with the lower floor slabs. The form work is then constructed on the lower floor slab and the beam web poured from the upper floor form work at the same time as the column. The top member of the truss is poured with the third floor. These trusses are comparatively easy to erect, the heaviest unit of steel to be handled being under 600 lbs. They possess great monolithic strength, and at the present time certainly cost no more than structural steel construction.

Lightness of Construction

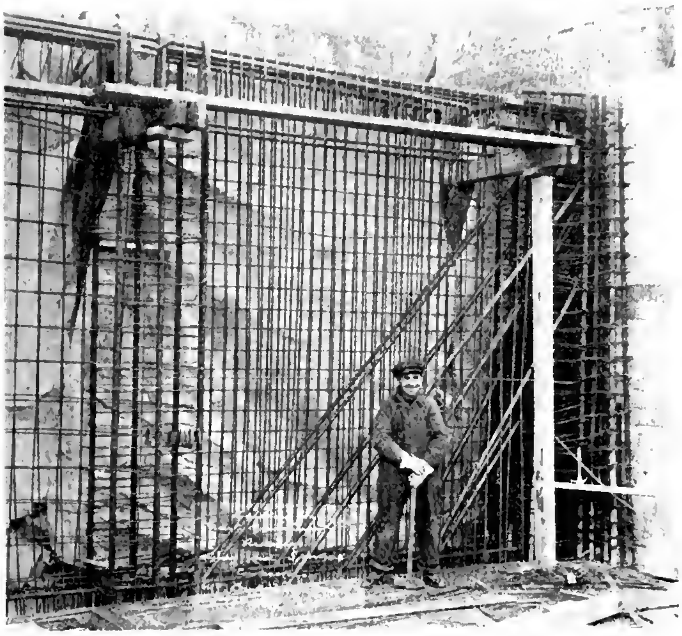
One is naturally impressed with the lightness of the reinforced concrete construction in this building. The main beams on the upper floor are 24 ft. and 27 ft.

Floor view showing reinforcement for main trusses, beams and slabs.

clear span, 14 ft. 6 ins. on centres and the depth of construction over all, from finished floor surface to soffit of plaster finish is only 20½ ins. The secondary beams are 5 ins. wide and 14½ ins. deep (including floor slab and finish). The main columns carry loads up to 560 tons per column. They have a clear height of 22 ft. 6 ins., and, in addition to the wind stresses, carry a cantilever balcony 13 ft. 6 ins. wide, as noted in the cross section. These columns are 32 ins. x 32 ins. There are two columns in front of the building, 25 inches in diameter, having an unsupported height of



Reinforcement of one of the concrete girders. Owing to the great depth door passages are provided through the truss.



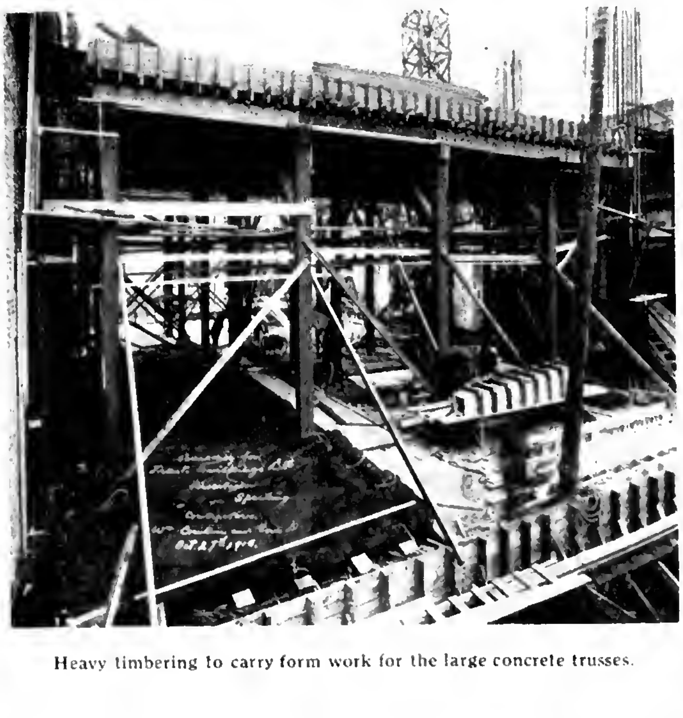
Junction of one of the large concrete trusses with column showing main reinforcement in position.

about 38 feet, carrying a load of 260 tons, in addition to wind stresses; these columns are incased in stone.

The samples of concrete used in the construction, when tested, gave a crushing value between 4,000 and 5,000 lbs. per square inch at an age of four to six weeks.

The exterior walls are of Don Valley Grey stock backed with hollow tile. The front is of Indiana grey stone, designed in bold effective lines and well carried out by Scott Bros., the cut stone sub-contractor.

The walls of the main banking room are finished in Tavernelle marble, which also forms a cornice around the Mezzanine floor. The effect is particularly pleasing; a feature of this floor is the main stairway in marble leading to the upper floors. The design is very effective and the construction, which was exceptionally difficult, has been excellently carried out by the Hoidge Marble Company, who had the sub-contract for the marble work.



Heavy timbering to carry form work for the large concrete trusses.

Absence of Columns Gives Good Light

The good light which is obtained all over the main floor is surprising in view of the depth of the building. This is partly due to the absence of columns and partitions. The entrance hall is divided off from the main office by a handsome bronze grill executed by the Architectural Bronze & Iron Company.

In the basement are very strongly protected safety deposit vaults with coupon booths and all the most modern improvements attached.

The foundations of the whole structures are carried down to solid rock on eighteen piers, extending to a depth of 27 ft. below the level of the sidewalk. The material met with in the cellar excavation was a very stiff, blue clay, underlain by strong hardpan down to solid rock.

The first three floors of this building are occupied by the Trusts & Guarantee Company, and the remaining floors are rented for general office accommodation. At the present time only seven floors have been constructed, but it is anticipated the company will complete the building in the near future.

The architect on the Trusts and Guarantee Building was Wm. F. Sparling, Toronto, the general contractors, William Cowlin & Son, Toronto, and the reinforced concrete was designed on the Hennebique system by the firm of Mouchel and Partners, Toronto.

Grand Trunk Railway Erecting New Station at St. Catharines, Ont.

WORK has been commenced on a new station for the Grand Trunk Railway at St. Catharines, Ont. It is being erected on the site of the old building, but will be considerably larger than this structure. The main building, containing waiting rooms, office and baggage room, will be flanked by large platform shelters, and a Canadian Express building will adjoin at the further end of the western shelter.

The construction will be of brick with concrete foundation. The outside walls will be faced with Hocking Valley vitrified brick, with grey sandstone dressing, and the roof will be covered with asbestos shingles. The station floors are to be finished with marble terrazzo and the baggage and express room floors with cement. The interior finish will be of Georgia pine and oak stained to bog oak color, the walls being plastered and painted and the dados panelled and finished with burlap. The seating will be of oak, stained to match the interior finish. All the lavatory walls will be lined with tiles to a height of four feet.

One-Storey Building

The station proper will be one storey, consisting of one large general waiting room 77 ft. by 22 ft., with an alcove 22 by 10. Smaller waiting rooms with lavatories lead off from this general room, these rooms being 16 by 10 and the lavatories 11 by 10. The ticket office, approximately 20 by 14, is to be placed on the centre line of the general waiting room opposite the alcove. It will have a large projecting bay in which will be placed the telegraph operator's table. A panelled oak screen will enclose the office and will also project into the general waiting room, provision being made for two ticket wickets.

The baggage room, at the west end of the station, will be entered by a door under the platform shelter and a wicket is to be placed in direct communication with the general waiting room for handling small hand baggage. The station will have three entrances, two directly facing the tracks and one from the platform shelter at the east end. The basement will be utilized for the steam heating apparatus and the storage of coal.

The Canadian Express Company will be housed in a building 44 by 28, situated 63 feet from the station proper, the intervening space being roofed to form a platform shelter. The platform shelters cover an area of 4,500 square feet and the buildings an area of 5,000 square feet.

Montreal Health Board to Approve Plans

Acting on a legal opinion by City Attorney Laurendeau, it has been decided by the Montreal Board of Control that all building plans must be approved by the Board of Health in addition to the city architect.

Organization, Advertising and Salesmanship Count in Selling Contractor's Services

IN the last issue of the Contract Record, Leonard C. Wason, president of the Aberthaw Construction Company, indicated the methods employed by large construction companies, and his firm in particular, in selling their services for private work. A contracting organization has nothing to sell but its services, but the marketing of these calls for a display of effective and intensive salesmanship to get results. In the article which follows, J. P. H. Perry, contract manager of the Turner Construction Company, gives his ideas on the matter of selling services, or, in other words, obtaining contracts. In the next issue W. P. Anderson, of the Ferro Concrete Construction Company, will present his views. Hard, intensive selling, backed by a good reputation, will, in Mr. Perry's opinion, win results. Advertising as extensive as possible, plus a perfection of organization, are further vital requirements in closing contracts. Mr. Perry's article follows:

Selling a concrete building to its owner usually really means the getting of the contract to erect such a building. It seems to me that fundamentally it makes little difference whether we are out to get a lump sum contract, a cost plus percentage contract, or a cost and profit-sharing contract, or any of the many service forms of building contracts—the underlying problem is to get the job. The perfect salesman for this class of business is the fellow who can get the contract.

It has been my experience that contractors weaken their selling campaigns the moment they attempt to dictate to the prospective customer how that customer shall do his business. Our position has always been that we were out to sell our services to our customers on any fair basis, and that the form of contract they chose was of secondary importance.

Suppose you hear of a factory that is going to be built and you decide you want the contract.

Driving Home Selling Arguments

You've got considerable of a task to make the proper approach and interest your prospect in your proposition. Perhaps you have, first of all, to sell concrete as compared to steel or mill construction if the status of the building, so far as materials or construction is concerned, is not already established. That accomplished, either by you or previously, next comes the presentation of the actual contract-getting talking points, such as your company's record of work done, its present readiness to erect the building in question, its financial strength, and the perfection of its organization. Then the merits have to be made clear of such factors as the plant ready to send to the job at once, the liveness of the traffic department, the speed records, and what certainty of delivery means, and, above all else, dependability of performance.

To drive home to the buyer's inner consciousness, to that part of him which actually moves himself as distinct from the external casual momentary side of him, these selling arguments, and also to make each of the many other talking points count and win; to tell this story so that the listener will believe it, and, what is more, believe it so he knows unalterably that what is back of the salesman is the best on the market—all this is ordinarily as much as the salesman can hope to accomplish.

If you bring up the question of the particular form of contract that the contractor will alone accept you add to the salesman's task and bring in a new element which really is a subject by itself and but a detail of the big selling problem.

Keeping at it Lands the Contract

The statement has been made that no selling is possible except when the contract takes the form of a service or percentage document. I want to take exception to this statement. I know of many instances where hard, intensive selling—such, for example, as interviews, telephone calls, frequent telegrams, photographs, monthly, weekly, daily, twice a day, influence channels properly worked, printed literature, inspection trips to similar jobs—where such good, hard sweating has landed the contract at a preference in the straightest and hardest kind of competition.

Two instances particularly are in my mind—one a competition of lump sum bidding of ten bidders for a million-dollar job, where the fifth from the bottom bidder secured the job at $60,000 preference. Hard selling, backed by unblemished reputation and unusual speed records, influenced the board of directors to pay the premium. Another case of a nearly million-dollar job, thirteen bidders, the pick of the country—straight lump sum bids, nearly $80,000 preference to the ninth highest bidder. Selling did it.

The intelligent owner starts out not to buy a particular kind of contract, but to select the contractor he believes will serve him best. Of course, if the contractor can persuade the owner to award the job without competition, so much the better: and for this kind of a deal the service of percentage contract has many merits and advantages and is rapidly coming into force.

In fact, the writer's company, out of 32 concrete buildings contracted for in the first five months of 1917 handled 26 on a cost and percentage basis. But as far as the general selling problem is concerned, the form of contract is secondary. Sell your services first and then sit down with the lawyers to sign the papers. The contract form is but one of the good building salesman's many talking points—to be used as needed.

Industrial executives, in letting building contracts, may, in my experience, be divided into two broad classes, and I believe this division applies pretty widely to any set of buyers:

First, the man (or company) who wants what he wants more than the money it costs.

Second, the fellow who thinks more about the price than he does about his purchase.

The Man Who Places Cost Second

No. 1 you can sell. He wants a good building, built on time, and is willing to pay a fair price. Secure his confidence and let him write his own contract, (whether he takes competition or not depends on the salesman or on unchangeable conditions). There is, as other builders have well pointed out, no better line of attack than to reach your man through his own industry or his own friends. Another good way to sell buildings is to let some one else sell for you. Impartial opinion, real or ostensible, goes miles beyond prejudiced salesman's talk. Architects or engineers should be cultivated to this end.

Often competitive bids are taken by this first class of buyers, but they select from their bids the concern they believe to be the best. Of course, price has to be considered, but is of secondary importance. A good building salesman keeps it there. The refusal of a job at a price lower than your bid is a situation to be sought and of great value when secured.

No. 2 can also be sold, but it is a far harder accomplishment and rather rare, unless we consider getting a job on price selling. Personally, I think it is order-taking. Price alone is being more and more talked out of the modern contracting business, but it's a mighty big factor yet.

Perfect Organization, Energetic Advertising, Intensive Selling

The architect and the engineer are susceptible to the same line of thought as the owner. Of course, the details of approach, argument, and closing are radically different, but the foregoing principles are fundamentally correct here as well.

In selling reinforced concrete buildings a man is arguing the merits of a material or of a class of construction.

In getting a job the contractor is, of course, selling services. Often the two problems dovetail. It seems to me, however, that for either or both the following requirements are vital to successful selling:

First—Perfect your organization to the point where it can and does do what is claimed for it. Overstatements of merit give but temporary success.

Second—Advertise energetically and as extensively as your purse affords. Job signs, booklets, photographs, magazines, newspapers—all are effective.

Third—Intensively sell by means of men of pleasant personality who know their game—that is, are experienced in the concrete construction field, can design broadly and advise knowingly, and, above all, who have energy and courage and won't take no.

Concrete Piles

Concrete piles are either pre-cast or cast in place and all of the former and many of the latter are reinforced. They have become an indispensable element of sub-structure work and when properly selected, designed, constructed, and installed often secure very high economy and efficiency.

When the type is not properly selected to conform to conditions and requirements, or when the construction or installation is faulty, they may become not only undesirable but very dangerous. Some types of concrete piles that under the most favorable conditions give excellent results, are so liable to develop very serious imperfections, generally concealed and often unsuspected, that their use has been officially prohibited in some cases, while other types are of such a character that their integrity cannot be impaired by local conditions and they may be safely used without hesitation.

It therefore follows that either the unimpeachable type should be used or that great care and experience should be given to the selection and installation of piles of other types for responsible service.

Properly designed pre-cast piles require large storage space, careful handling and installation, and must be made and seasoned some time in advance of their use. They are especially adapted for driving in soft ground and with an hydraulic jet. They need special reinforcement and cushioning to resist driving shock and are liable to be shattered by impact with hard strata.

Piles with Steel Shells

Piles made with a steel pipe driven to refusal and lined with concrete, can develop not only the very considerable strength of the steel shell alone as an independent column, but the strength of the concrete core is materially increased by the shell acting as a continuous hooping, beside which there is an almost unlimited additional strength that can be obtained by the addition of vertical reinforcement bars.

Such piles can endure very hard driving, can be thoroughly inspected inside, can have satisfactory bearing assured at the bottom and can be reinforced to a high degree of strength comparable with massive structural steel columns. This reduces the number of piles and the cost of driving, and gives freedom from all uncertainty or possible deterioration from subterranean obstructions. The large factor of safety in the shell permits the safe application of working loads before the concrete filling is hard, which is often an important advantage.

Cast-in-place piles without very efficient, permanent, exterior shells to protect the concrete before it is fully hardened, and piles that can only be driven to a limited depth, that have materially reduced bearing at the lower end, or that are not adapted to unrestricted reinforcement, or that cannot be inspected after driving, or that do not provide for examination and rectification of bottom bearing, lack many of the important advantages above enumerated, and in some or many cases are liable to develop dangerous defects or to fall short of their potential efficiency.

It is doubtful if even initial economy is often gained by the installation of concrete piles lacking in important essentials and the able builder will be careful to select for important work the best type of concrete piles or fall back on wood piles that can be secured and installed with great facility in nearly all places and at worst merely need a special construction above water level to safeguard from decay.—Contracting.

Activated Sludge Process of Sewage Purification —The Worcester Experiment

(Continued from last issue)

By Thos. Caink, Assoc. Mem. I. C. E.*

The objectives to be reached are:—

1. Prolonged contact between air and liquid.
2. Simplicity and moderate cost of tank construction.
3. Suspension and fine subdivision of the solids, and aeration with a minimum expenditure of air.
4. Impossibility of short-circuiting of the liquid from the inlet to outlet.
5. Facility for draining tank in the event of its requiring to be emptied.
6. Easy removal of air diffusers for examination and changing.
7. Facility for observing progress of purification in the transmission of the liquid from inlet to outlet of aeration tank.
8. Adaptability to variations of flow from minimum dry weather to maximum wet weather, and from day flow to night flow.
9. Uniformity of forward movement of the entire volume of effluent, so as to obtain the maximum settlement of sludge with the minimum tank capacity.
10. Certainty of early and complete removal, and restoration to aeration tank of the deposited sludge.
11. Adequate length of weir over which the final effluent flows to its destination.

The accompanying drawing illustrates a tank designed with these aims to deal with a d.w.f. of 2,000,000 gallons of sewage, and a w.w.f. of 6,000,000 gallons per day. This would provide for a population of 50,000 with a water consumption of 40 gallons per head per day.

The internal dimensions of the aeration tank are 86 ft. 9 ins. and 18 ft. deep from coping to floor, and it has a net capacity of rather more than 650,000 gallons, with a depth of water of 17 ft. This capacity gives an aeration period for 2,000,000 gallons per day of six hours, and for 6,000,000 gallons per day of two hours, assuming a sludge proportion of 25 per cent. of the entire volume.

Wood Roof Facilitates Repairs

The tank is divided into ten longitudinal bays by walls running the whole length of the tank, the walls having their lowest course 1 ft. 6 ins. above the floor, and the top courses 2 ft. 6 ins. below the water-line. Nine of these bays are covered by a more or less air-tight roof, carried by arches resting upon the division walls. The best material for this will probably be reinforced concrete, but in the drawing appended the roof is shown constructed of timber, composed of 11-in. by 4 in. planks rebated at their edges so as to form a joint half an inch wide, intended to be filled with soft bitumen. This arrangement would facilitate the removal of any part of the roof for renewing the air diffusers when necessary, or for other purposes. One of the longitudinal bays is left uncovered for the exit of air used for circulation and aeration.

A row of diffusers, which are suspended by wrought iron tubes from the cast-iron main, running above the roof, extends along the entire length of the bay, at the opposite side of the tank to that of the unroofed bay. Other diffusers, similarly suspended, are distributed over eighty other bays, at distances apart of about 8 ft in all directions. Over each of the latter diffusers a shield or deflector, 4 ft. square, consisting of elm boards, submerged 3 ft. below the roof, is suspended.

In the wall separating the aeration from the settling tank a number of openings for conveying the liquid from the former to the latter are provided.

The dimensions of the settling tank are 86 ft. 9 ins. long, 25 ft. wide, and 21 ft. deep. The depth of water from the crest of the overflow weir, which is level with the underside of the roof of the aeration tank, is 20 ft. The settlement tank is unroofed; its capacity is 250,000 gallons, and gives a settling period of three hours for 2,000,000 gallons per day. The floor is flat over its entire area.

Syphon Mounted on Carriage

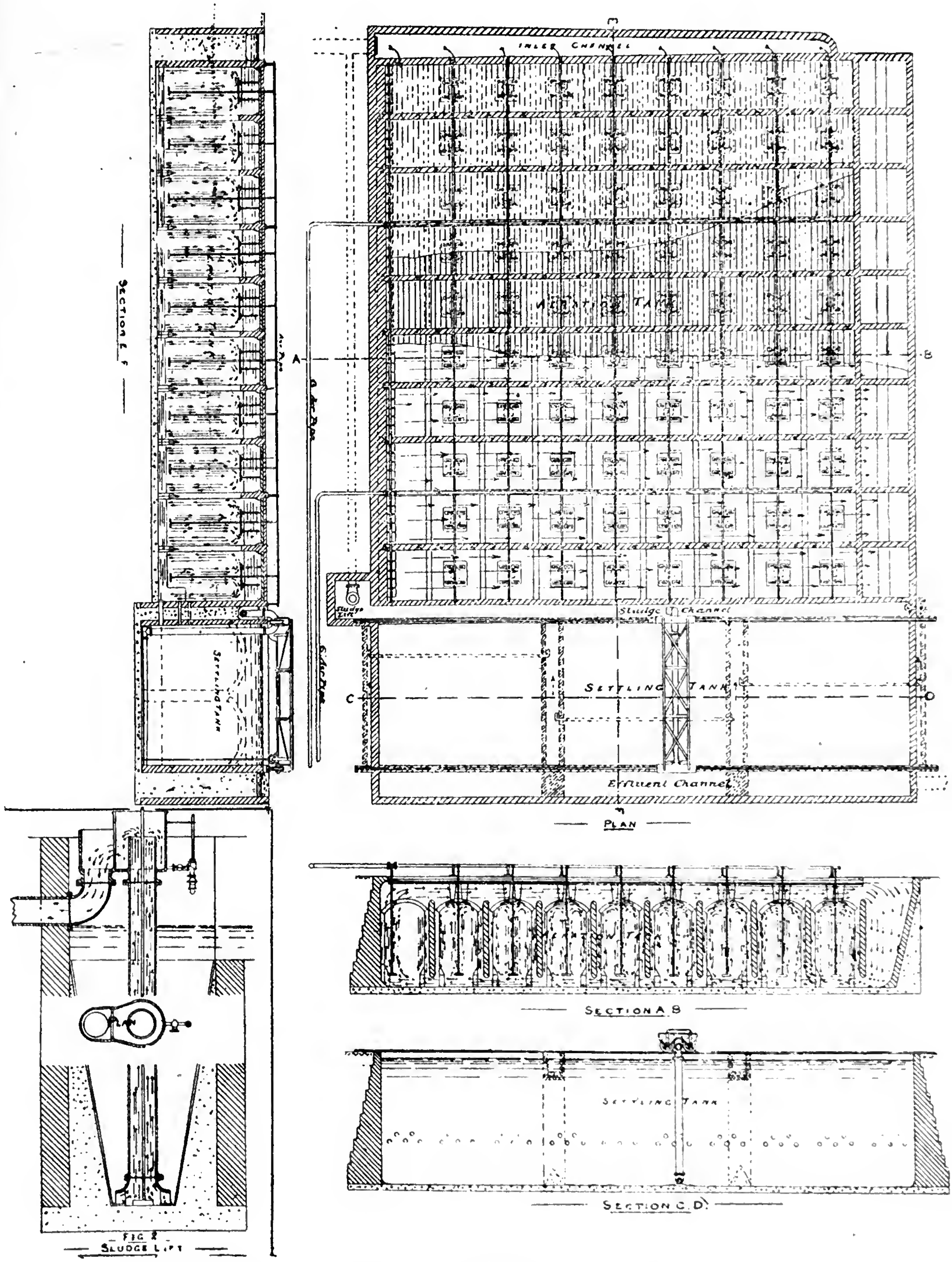
A syphon, having its horizontal limb about 3 ins. above the floor, stretches across the length of the tank, its vertical limb, which is 10 inches in diameter, discharging into a channel running between the aeration and the settling tanks. The horizontal limb is perforated, and carries a series of scrapers pivoted upon a rod below the pipe, the other ends resting on the floor.

The syphon is suspended from a pair of wheeled carriages which run upon steel rails, laid on each side of the tank upon trunnions, whereby the submerged portion of the syphon may be easily lifted to the surface for examination and removal of the scrapers when necessary, without emptying the tank or otherwise interfering with the continuity of the operation. A small electric motor mounted upon one of these carriages, drives the syphon through speed-reducing gear to and from end to end of the tank.

This is probably the most convenient form of drive, but generally there would be ample power in the flow of the effluent to give motion to the syphon, without the small expenditure of electricity. The effluent weir runs the entire width of the tank, and conveys the water to a channel which discharges into a culvert, conveying it to the river.

The action of the plant will have been anticipated from its description. The tank is filled to the underside of the roof from the inlet channel with raw sewage, admitted through nine openings spaced at regular intervals along the channel. Air is blown through the diffusers into the liquid, but instead of immediately escaping at the surface into the atmosphere, it is forced along under the roof to the only exit at the opposite end of the tank in a stream of water which flows at a velocity depending upon the volume of air transmitted through the diffuser. As this is happening throughout the whole length of the tank from inlet to outlet, the upper layer of water over the entire area is set in motion in the same direction from the diffusers to the

* Worcester City Engineer, before Conference of Managers of Sewage Disposal Works.



Design for Aeration and Settling Tanks for Treating 2,000,000 Gallons per day, D. W. F.

opposite side where the uncovered portion of the tank offers an escape for the air.

Moving Belt of Water

The stream of water creates a head at this point, setting up a return current, the intervening walls forcing the stream to flow along immediately above the floor with a scouring velocity, effectually preventing the lodgment of solid matter thereupon.

A moving belt of water is thus created over the entire area of the tank. As, however, the sewage is constantly entering the tank and moving towards the outlet, each particle of water in the belt will assume the direction of a spiral or screw, the pitch of which will depend upon the relative velocities of the forward motion, due to the inflow, and of the circumferential motion, due to the influx of air, and, by this spiral motion, eventually reach the settling tank.

The openings which convey the raw sewage from the inlet channel into the tank are placed at such a level as to be near the middle line of the upper moving belt of water. The sewage, therefore, is immediately caught in the vortex and carried round the spiral stream, thereby preventing the possibility of short-circuiting—that is, of taking a more or less direct course to the outlet.

Action of Isolated Diffusers

It will be seen that the mass of liquid lying between the moving zones is more or less stationary. In order to give motion to this water sufficient to keep the solids in suspension, and to give an adequate supply of air to the organisms, the isolated diffusers are provided. The air from these rises through the liquid and is deflected by the shields escaping at their edges, contributing more air to that in the upper layer and adding to the velocity of the moving liquid, at the same time causing a local crater-like circulation of the water to be set up by each diffuser.

It will be noticed that there are three distinct motions given to the liquid—the flow from inlet to outlet, the circumferential motion, and the crater-like motion—the actual movement forward being compounded of all three.

The question may be asked, What is the most economical depth for the aeration tank? The following theoretical considerations may be of service in answering this question, although the actual depth which may be economical for any particular case will, of course, greatly depend upon the circumstances of the site and the nature of the ground encountered.

The energy expended in creating a velocity of current is almost entirely absorbed by friction. Hence the shorter the distance the stream has to flow, the smaller is the friction developed for a given velocity, and consequently the less the energy absorbed in overcoming it.

Tank with Least Friction to Current

The form of rectangle of a given area which has the shortest periphery is, of course, the square; hence a rectangular tank which would offer the least friction to the circumferential current, in the method last described, is one of which the depth would equal its breadth.

In practice this would generally be out of the question, because a tank 100 ft. wide would have to be 100 ft. deep. But the consideration shows that, other things being equal, the deeper the tank the less loss of power in circulating the water at a given velocity.

Take the following example. In a tank of a width of 100 ft. and a depth of 10 ft., the water would travel 10 + 100 + 10 + 100, total 220 ft. In a tank of the same capacity 50 ft. wide and 20 ft. deep, the water would travel 20 + 50 + 20 + 50, total 140 ft. The difference in the energy required to overcome the friction for the same velocity of current in these case would be appreciable.

In considering adaptability to variation of flow, it is clear that a tank capacity, both for aeration and settlement, must be provided to deal with the maximum quantity intended to be treated, and that the entire sludge content of the aeration tank must be kept active by maintaining alive the oxidizing organisms, and that can only be done by a more or less continuous supply of air.

Experience has shown that a more diluted sewage does not demand so long a period of aeration as a stronger one. It may provisionally be taken that double the tank capacity which is required for the d.w.f. will suffice for three times that flow diluted with storm-water. Hence, if the full capacity of the tank capable of dealing with the maximum flow be used for the d.w.f., it follows that it will receive twice the aeration period in its transit through the tank that it needs.

Fill and Draw Method

The "fill and draw" method of the activated sludge process showed that adequate activity of the sludge could be maintained by intermittent aeration, provided the period of rest was kept within certain limits. Two hours seemed to be quite a practicable interval. By the arrangement which has been described, advantage may be taken of this circumstance to employ one-half of the tank at a time for the d.w.f., alternating the two halves at short intervals of, say, half an hour or less.

Separate Air Main

This can be easily effected by carrying a separate air main from the compressor to each half of the tank, and controlling them by a three-way valve. This might be operated either by hand or automatically through an electric motor by a timing arrangement. If the latter be adopted, the intervals of change might be made still shorter. The principle might be extended to adapting the consumption of air to variations due to a day and night flow.

The total area of diffusers, each of which is 15 ins. square, is 20 square feet, being 1.29th of the water area.

With an initial pressure of 9 lbs. per sq. in., the consumption of air with this area of diffusers would be 0.22 cubic feet per gallon of sewage treated. The consumption of electricity for the air supply would be about 174 units, which at ¾d. per unit amounts to 10s. 8d. per million gallons for the d.w.f. and less for the w.w.f.

These figures are based upon an aeration period of six hours. If three hours' aeration suffice, which is frequently found to be the case, then the method of alternate working of the two halves of the tank previously mentioned might be adopted.

In that case the cost of the air supply would be reduced to 5s. 4d. per million gallons. These costs would, of course, be further reduced in the proportion in which the power production costs may be diminished.

For large installations, probably the steam turbine driving a turbine air compressor would prove the most economical.

In other instances, high-compression types of oil engines or suction gas-producer sets would have the advantage.

Having regard to the comparatively small capital outlay involved in installing a fully-equipped plant for the process, the author believes that no other method of sewage purification will for economy approach that of the activated sludge process, and, from the point of view of freedom from the risk of nuisance, is probably not equalled, and certainly is not surpassed.

To give any period of aeration that may be determined upon, 25 per cent. should be added to the net capacity of the tank which would provide that period, in order to allow for the volume of sludge present, upon which the purification mainly depends.

The quantity of wet sludge is in this scheme assumed to be 25 per cent. of the total volume. This quantity generally takes from two to three months to accumulate.

The aerated liquid, mixed with its full complement of suspended sludge, passes into the settling tank through a number of openings in the portion of the wall situated between the two rapidly-moving belts of water. This arrangement has the effect of giving a slow forward movement to the entire mass of liquid in the tank, thereby ensuring the maximum settlement of the sludge. The latter is drawn away through the perforations into the horizontal limb of the syphon and discharged into the sludge channel which conveys it to a well, from which it is lifted by an air sludge lift into the pumping main conveying the raw sewage, with which it gets intimately mixed and returned to the aeration tank.

Sludge Lift Avoiding Pulsation

Fig. 2 shows a new design for a sludge lift which possesses the advantage of avoiding the semi-intermittent pulsating action common to air lifts, and also of indicating the density of the sludge lifted. This latter is important, because while it is imperative that all the sludge should as rapidly as possible be removed from the settling tank, it should, for economical reasons, be accompanied by a minimum quantity of free water. The device enables the density to be kept under easy observation, and consequently the proper quantity of air required for lifting the sludge readily ascertained and controlled.

At the opposite end of the sludge channel to that of the well a valve is provided for drawing off the excess sludge for disposal. This is conveyed through a drain to the drying beds.

A settlement period of about two hours seems to be sufficient in most cases. The drawing shows a tank of a capacity equal to three hours d.w.f. of 2,000,000 gallons per day, which would give one hour for three times the d.w.f. Whether this would suffice for the w.w.f. would largely depend upon the size and character of the stream into which the effluent would be discharged.

Bridges Over St. Charles River

The Federal Government have received tenders for the construction of a double-span steel-plate girder bridge over two sluiceways in the St. Charles River, Quebec. The plans show a bridge with two spans 60 feet long (with double tracks), and 8 feet centre to centre of girders, with a sidewalk having a clear width of 6 feet on one side, running the entire length of bridge, supported by steel beams and wooden stringers. Two lines of hand-railings will run the length of the structure. One condition is that the traffic of the C.N.R. and the Quebec Railway, Light, and Power Company must not be interrupted during the work.

Canadian Engineer in East

Finds Life Both Interesting and Strenuous — Reached Bombay via Capetown

By L. W. Wynne-Roberts

[Lieut. Lewis Wynne-Roberts, R.E., formerly of Regina, Sask., having been selected for duty in Mesopotamia, left England in March last. He has made the voyage down the west coast of Africa, visited Capetown, Durban, where he spent a few weeks, and lately arrived in Bombay. He is now at Bangalore, attached to the 2nd Sappers and Miners. He wrote from Bangalore on June 17 last. Letters written from Bombay have not yet reached here.—Ed.]

Nearly at Bombay, June 7, 1917.

AS you see by my heading, we are nearing our destination, and preparations are being made on board for disembarking.

To-day is Thursday, and we expect to reach Bombay on Sunday, and a mail will leave this boat immediately we arrive in dock; therefore, I am writing now, in order to catch it, and let you know things are. Our departure from Bombay naturally provoked many rumors. We didn't go on the day everyone thought we should, and eventually left when no one in the least expected, after summoning the bigger pots on board hurriedly.

We have had several thousand troops on board, a couple of hundred officers, and half a dozen ladies, two of whom were wives of officers going to German East Africa and the other four were Australian nursing sisters going to Bombay. The latter have had a jolly good time with such a galaxy of officers on board, and made the most of it.

Among the officers were two generals, going to German East Africa, and their staff. One of the generals is the new general commander in chief in that scene of operations. Both of them were very large and very broad. The G. O. C. is a Dutchman, and speaks English but little, but is favored by the good opinions of South Africans.

We left Durban at 4.30 in the afternoon, with a convoy of transports, intending to drop the East African officers at Dares Salam or Zanzibar. About a day out of Durban it was discovered that some of our coal bunkers were on fire, and we left the rest of the convoy, going at full speed—some 20 knots. However, the fire got out of control, although a large number of the troops rendered assistance—later recognized and given thanks for by the naval commander-in-chief—and we had to put into an uninhabited bay, 200 miles south of Dares Salam. Boats came to us from that place and Zanzibar and took off the East African crowd.

After some five days of hard labor they got the fire in hand and we proceeded again—much to everyone's huge delight.

We were met by a cruiser and were ordered to proceed direct to Bombay with no further calls ,and so here we are. Apart from unpleasant experiences during the fire, we have had a good trip. The sea latterly has been rough, but as the boat is a very large one, she does not make much fuss about it. We covered nearly 12,000 miles, and have taken 86 days since our embarkation at Devonport.

All our draft are awfully curious as to what will happen to us. Shall probably know before this time next week. Life on board is getting very monotonous.

I have done a great deal of reading, both light and heavy matter, and text-books which refer to our particular work.

We have a bi-weekly paper published on board, "The Somewhere Bullet-in," and if I can send it from Bombay with any degree of safety you shall have the full series.

I have been sleeping up on deck every night, as down below it is fearfully fuggy, as portholes and doors must be closed in order to screen the lights. The cabins are also the scenes of many big game hunts. I've never seen a place so infested as this boat is with many undesirable inhabitants.

To finish the tale of the Coronia—our transport—about two days out from Bombay we came into a monsoon, and had a lively time. It blows hard and most torrential rain, so that the ports have to be closed entirely, and one daren't go on deck, as the rain gets everywhere. One blessing of the monsoon was that it broke the warm weather, and we've had it comparatively cool since.

We reached Bombay on Monday morning, and had to wait outside all day, waiting for a high tide to take us in early next morning. Bombay harbor is very pretty, surrounded by small hills. The city looks just like what one would expect an Indian city to look like from the sea, and a number of hospital ships and cruisers tend to give it quite a warlike appearance.

Tuesday morning we proceeded in, passing through a lock to get into the basin—our whole progress being very slow, due, I suppose, to the size of our boat.

About 10 a.m. we were tied up, and many varied officials came on board—one to advance us 300 rupees—the most popular man of all—another to tell us all where we were posted. Of the 19 of us who came from Newark 7 have come here (Bangalore), 6 to Kirkee, near Poona, and 6 to Rawalpindi, away south. We are told that we have the pick of the stations. After getting orders, our next business was to find the train and our railway warrant. We were told to leave on Wednesday evening, which gave us a clean 24 hours in Bombay.

Bombay happened to be very full of officers on leave from Mesopotamia, and it was only with some difficulty we got room at an hotel.

My room was large, possessed a bed with a mosquito curtain, an electric fan, bathroom, etc., and was quite comfortable. The most astounding thing we found was the number of menials who wanted a tip. If you ever asked one to do anything, he would pass on the request to another and he to another until you got to the one who was of the lowest grade, and then one and all would come to you for tips.

The remainder of the afternoon we tried to find our way about Bombay streets, by no means an easy matter. There are several fine buildings in the city, and everything seems modern enough, with tramcars, etc., but the whole city is cram full of Indians of various castes—the white people were very few; of course, this is the "Hill" season, and many would be away on holidays.

We had dinner at 8.15 and after dinner proceeded to a show, which started at 10 and finished about 12.30 a.m. This, by the way, was the time of commencement of all theatres in Bombay. Wednesday turned out a glorious morning, and, after seeing to certain details of our travelling, we took a taxi and motored around the city, visiting Indian temples, zoological gardens, native bazaars, etc., and got some idea of what the place looked like. One interesting place was the Parsee burial ground, which was swarming with vultures. The Parsees do not believe in burial, but allow the bodies to be decomposed by air and eaten by birds.

In the afternoon we made for the Silk Bazaar, and spent a couple of hours looking at most wonderful silks, shawls, scarfs, table centres, kimonas, etc. We didn't invest in anything much then, but shall when we next visit Bombay.

We left by the Madras mail at 9.30, in curious compartments, each holding four people, the berths arranged over the other in twos. There is no connection between your compartment and the next except by going on the platform. The trains do not carry dining cars, so you get your meals at stations en route—very good meals, quite cheap, with partiality to chicken. The country we passed through was surprisingly like certain parts of England and the Canadian prairies—quite flat, with a few trees here and there. It was hot, as you can imagine, but a fan in the carriage helped things along. Nothing exciting happened on the trip, and we arrived at Bangalore on Friday morning, being met at the station by one of the officers.

Search the Scrap Piles

UNDER this caption, a contemporary makes a plea for saving cast-off industrial machinery and equipment, especially at this time, and urges the salvage of all odds and ends that might be useful. Its appeal follows: American extravagance has not been confined to food and household supplies. In the rush for efficiency in output, much industrial machinery and equipment, or parts and supplies, has gone to the scrap pile for lack of adequate scrutiny with a view to its reclamation. The present unparalleled demand on our stores of metal, and the difficulties of freight transportation, are resulting in more repairing, less discarding, and wider utilization of shop odds and ends. There is coming, moreover, deeper and deeper search of scrap piles for accumulated pieces that may be salvaged. One notable instance of what may be done deserves more than passing notice—the accomplishment of oxy-acetylene processes of cutting and welding, resulting from certain missionary activities of the sales promoters of commercial apparatus.

It is reported that at one Western mine, a three months' supply of dollies and dies was secured by welding up the old ones in the discard—at a cost of only $1 each, compared with $9 for new ones. There was also found in the scrap, recoverable stamp stems enough to last three months. Short ends of tungsten steel were welded together and the supply replaced purchases for a year. Some oversized manganese-steel crusher plates costing $20 each were cut down by the gas flame and put to use. In a certain railroad shop there was a wealth of old locomotive drivers with cracked spokes. The cracks were welded and the wheels made to turn again. A shortage was experienced in boiler tubes for renewals, but in the tube junk there were sufficient good short lengths to be welded into tubes for all the engines awaiting renewals. Such instances could be multiplied; we look to see their number grow until they excite no surprise. The possibility of many similar conservation services is strong—as from alumino-thermic welding of heavy pieces. The reclamation of the scrap pile has only started.

Physical Tests for the Materials Used in Building Gravel and Sand-Clay Roads

MODERN methods of testing materials for highway construction have been developed during the past 40 years. Prior to that time reliance was placed either upon service tests or upon the appearance of the material and the opinion of its suitability from merely a superficial inspection. If the service test was used as a means of selection, a sample road was constructed with the material in question, and observed for a period of not less than one year. If the material proved satisfactory it was then used for more extensive construction. Naturally, this practice had a tendency to favor certain materials that had previously been used with success, since the expense of conducting service tests was great, and experimental construction with unknown materials was avoided as much as possible.

Tests Approximate Road Conditions

However, out of the use of these service tests have developed our modern tests of road materials. Engineers began studying the physical properties of materials that had been used successfully in road construction, and as a result worked out a system of tests which give an indication of the properties desired in only a few hours, where they had previously waited at least a year before being able to come to any definite conclusions. These tests are so devised that they approximate conditions on the road, but the element of time is eliminated. Therefore, if we take advantage of the laboratory tests so devised we thereby profit by the experience of the past 40 years and save ourselves the expense and time necessary to make extensive service tests.

It is a deplorable fact that much work is being done without making either service or laboratory tests upon the materials used. This was considered poor practice forty years ago and should be looked upon at present as absolute folly. The service test is often absolutely out of the question, however. Good judgment then demands that we turn to the laboratory to get an estimate of the material we propose to use before investing large sums of money in experimental construction. Laboratory tests are conducted as a means of approximating the results to be obtained when using the material on the road, and by making them we simply insure ourselves against the expensive errors due to the use of improper materials. This article, which is an abstract from a bulletin issued by the Texas Engineering Experiment Station, describes some of these laboratory tests as applying to gravel and sand-clay roads.

Tests Necessary During Construction

The natural sources of material are of such a variable nature that they make it necessary to conduct tests during construction as well as before starting the work. Gravel, for example, should be tested before beginning construction. As the work progresses, material obtained is usually of a different nature from that of the original sample tested. Different parts of a gravel pit usually have different percentages of clay present and nearly always have a different variation in the sizes of particles making up the gravel. Since the preliminary tests of the material were not made upon samples that represent the gravel now being used, it therefore becomes necessary to make other tests as the work progresses. What is true of gravel is also true of other sources of natural materials as sand pits and even rock quarries, although it is not so pronounced in the latter case. In general, it may, therefore, be said that the sample must be truly representative of the material actually used in construction, or the testing is absolutely useless.

The laboratory tests applied to a material should be determined by the function of that material in the structure. For example, a rock that is to be used for water-bound macadam construction should be tested differently from one to be used as an aggregate in a concrete pavement. Again, a rock that is to form a part of the aggregate in a concrete pavement should be tested differently if it is to be used as an aggregate in a reinforced concrete bridge. In explaining the tests in this bulletin it is the purpose of the author to try to show the relation of the tests used to the function of the material in the structure.

Tests of Gravel

Function of the Gravel.—Since the surface of the road is composed entirely of gravel it is necessary that it be of such a composition that it can withstand the effects of traffic without the addition of other material. This makes it necessary to have a combination of several important properties. As in the construction of a water-bound macadam road, the material must be able to bear up under the weight of traffic, withstand the impact and abrasive action of the wheels and horses' hoofs, and must have enough cementing material in it to form a hard, impervious crust over the top of the road.

Character of Material.—Since the material is made up entirely of comparatively small pieces it is impossible to make a test for toughness. Even if there are pieces of sufficient size to make the toughness test, there may be so many different minerals in the gravel that a test upon one or two pieces would not be sufficient to give an indication of the toughness of all the particles. For these reasons it is necessary to give up the toughness test and instead make a classification of the materials making up the gravel so as to get an idea of the nature of the rock from which the gravel came. From what is known of the material from which the gravel originated it is possible to get some idea of its toughness and hardness.

Must Possess Stability

Mechanical Analysis Test.—In order for the gravel to bear up under the weight of traffic it is necessary for it to possess some stability. If the particles making up the gravel vary in size so that the voids in the larger particles are filled with the smaller particles the resulting mixture will approach a solid in nature and consequently have a greater stability. To make this point plain let us assume a large number of round particles of exactly the same size. If these particles are placed in a pile it will be found that those underneath will roll out, allowing the pile to fall, while if a number of particles varying in size are placed together it will be possible to make a much higher pile without the particles underneath being displaced. It can be seen that there is a certain variation of sizes that is going to give the greatest stability. This variation in size can not always be obtained, but the nearer a material approaches it the more stable the mixture will be, and consequently the more desirable for purposes of construction, providing other properties are the same. For this reason a mechanical analysis is made of the gravel.

The following mechanical analysis limits are recommended for gravel to be used in the construction of gravel roads:

Base Course

All to pass a 2½-in. screen and to have at least 55 and not more than 75 per cent. retained on a ¼-in. screen.

At least 25 and not more than 75 per cent. of the total coarse aggregate (material over ¼ in. in size) to be retained on a 1-in. screen.

At least 65 and not more than 85 per cent. of the total fine aggregate (material under ¼ in. in size) to be retained on a 200-mesh sieve.

Top Course

All to pass a 1½-in. screen and to have at least 55 and not more than 75 per cent. retained on a ¼-in. screen.

At least 25 and not more than 75 per cent. of the total coarse aggregate to be retained on a ¾-in. screen.

At least 65 and not more than 85 per cent. of the total fine aggregate to be retained on a 200-mesh sieve.

Takes Abrasion Effect

Abrasion Test.—The larger particles of gravel are forced to carry the greater part of the load of traffic and take the effect of abrasion caused by passing vehicles, the smaller particles lodging themselves between them, thus acting as binding material and promoting stability in the surface. Since the large particles must resist the abrasive action of traffic it is well to make the abrasion test upon them. The sample of gravel used consists of pieces which pass a circular opening 2 inches in diameter and are retained upon a screen having circular openings ½ inch in diameter. Since this test gives an indication of the toughness and hardness it is interpreted in conjunction with the previous classification.

Cementing Value.—Since the gravel makes up the entire surface it is necessary that it possess sufficient binding material to hold the particles together. When first constructed the larger particles are held together by means of the smaller particles of gravel and clay. The test of cementing value is, therefore, made upon the fine material below the ¼-inch sieve. As the surface wears away there must necessarily be new cementing material formed in order to preserve the road. A test is, therefore, made upon the material that is larger than ¼-inch in diameter and also upon the gravel as received.

In the 1916 specifications for the wearing surface of a gravel road the United States Office of Public Roads requires: "The material passing a ¼-in. screen shall have, when tested in the manner described in Office of Public Roads Bulletin No. 44, cementing value of rock powders, a cementing value of not less than 50, and this material shall not contain more than 45 per cent. of clay."

Hard to Determine Clay

Percentage of Clay.—Practically all gravels are made up of more or less well rounded particles of rock mixed with sand and clay. There should be just enough sand to fill the voids in the rock and enough clay to fill the voids in the sand. This will make from 10 to 20 per cent. of clay which will act as a cementing medium. If the material contains more than this amount of clay the road constructed will be muddy in wet and dusty in dry weather, and consequently will not wear well. For these reasons a test of the percentage of clay is made on the gravel. There is no method, however, by which the exact amount of clay can be determined, but the following approximate method is ordinarily used. A sample of approximately 2,000 gm. is selected for the mechanical analysis test, and dried at 212 degs. Fahr. It is then placed in a shallow pan and water poured over it. The sample is then stirred for some time and allowed to settle for 15 seconds. The coarse material settled to the bottom during the 15 seconds and the water and suspended matter are then poured off. This operation is repeated until the water remains practically clear after stirring. The sample is then dried and the weight again taken. The loss in weight is taken as the amount of clay present and is expressed as a percentage of the total weight of the original sample.

Sand for Sand-Clay Roads

Function of Sand.—A good sand-clay road is made of a mixture of sand and clay in such proportions that the voids in the sand are just filled with the clay. This being true, the different particles of sand must be in contact with their neighbors. If they are not, there is an excess of clay in the mixture and during wet weather this clay will become plastic, allowing the said grains to slide over each other, thus destroying the road surface. Since the clay only fills the voids in the sand, the function of the sand is to hold the weight of traffic and furnish stability enough to keep the road in shape during wet weather. For these reasons the sand must be well graded and contain large particles. A fine sand has less stability than one grading from large to smaller sizes, it even being advantageous to have small pieces of gravel in the mixture, providing there is a variation in sizes from the larger particles down to fine sand. The only tests ordinarily applied to this material are the mechanical analysis and void determination.

Sand Must Have Stability

Mechanical Analysis Test.—Since the sand is depended upon to furnish stability to the mixture, and the clay simply holds the particles of sand together, it is absolutely necessary that the sand be graded in size so that it may have the necessary stability. The stability of any sand mixture may be increased by increasing the maximum size of the particles making up the mixture, providing the variation in size from the larger to the smaller particles is maintained. It is, therefore, very advantageous to have as coarse a sand as possible for this type of construction. The general tendency is to construct roads of this type using sands that are entirely too fine. To get an indication of the probable stability of the mixture the mechanical analysis test is made. The test is made by separating a representative sample of the finished aggregate mixture into its various sizes by running it through a series of sieves and weighing the amounts retained upon each sieve.

Void Determination.—Since the voids in the sand are to be filled with the clay it is well to get some idea of the voids by laboratory methods. The test is made as follows: Five hundred cubic centimeters of sand are placed in a graduated cylinder and sufficient water is added to completely fill the voids. The volume of water added represents the space occupied by air. In order to get an accurate determination of the voids by this method it is necessary to introduce the water slowly, and at the same time the sand is placed in the cylinder, so that all air spaces may be eliminated. It is, of course, understood that the void determination is made only to get an indication of the approximate percentage of clay necesary, and the results are not to be taken as final but rather as a guide upon which to base an estimate of the proper amount of clay to be used. As work progresses observations on the road will give an indication of what percentages of material are best.

Clay for Sand-Clay Roads

Function of Clay.—In sand-clay construction the clay is added to the mixture so as to hold the particles of sand together during dry weather. The clay must be of such nature that it will not expand during wet weather to such an extent as to separate the sand particles, since this will destroy the stability of the mixture.

Implicit confidence can not be placed upon laboratory tests upon clay for sand-clay road construction. For this reason it is always advisable to first make laboratory tests to get some idea of the probable action of the clay in the mixture, and if it proves good, as indicated by laboratory methods, to then construct only a few miles of road with the material until it has proved its worth by actual year on the road. The tests ordinarily applied are the slaking and shrinkage tests. Other tests are sometimes made, such as binding power and tensile strength, but these are not relied upon to give information of any great value.

Slaking Test.—There are two classes of clays, slaking and ball clays. Slaking clays readily crumble or slake when placed in water, while ball clays preserve their shape for some time. The slaking clays have the advantage that they readily mix with the sand and do not ball up when wet, but at the same time they possess the great disadvantage that they do not have such a high binding power as the ball clays. Clays that fall between these extremes are usually the best for road work. The slaking test is made upon both clay and sand-clay cylinders. Clay test pieces are made by mixing the clay with sufficient water to make a stiff paste from which cylinders 1 x 3 in. are molded. After the cylinders have been dried in a steam bath at 212 degs. F., it should take at least two minutes and preferably six minutes for the cylinders to crumble and fall to the natural slope of the material.

Shrinkage Test Determines Expansion

Shrinkage Test.—If there is sufficient clay in a sand-clay road to fill the voids in the sand when in a dry condition and the clay is of such a nature that it expands when wet, the sand grains will necessarily be forced away from each other, thus breaking up the stability of the surface mixture. If this expansion can be reduced to a minimum a more nearly stable mixture will result. To get an indication of this expansion the shrinkage test is made. In general the clay having the lowest per cent. shrinkage is the most desirable, provided the low shrinkage is not obtained at the expense of binding power. Test pieces are made by mixing sufficient water with the clay to form a stiff paste. Bars approximately 4 inches in length and 1 inch thick are molded from this paste, or the test pieces for the slaking test may be used. Marks are placed upon the test pieces as far apart as possible and the distance between them accurately measured while the paste is yet green. After the bars have been dried the distance between the marks is again measured and the difference in the two measurements is taken as the shrinkage. It is expressed as a percentage of the original distance between the two marks.

Thumb Test.—Another extremely simple test is sometimes made to get an idea of the binding value of the material and is known as the thumb test. The test consists of wetting the thumb and placing it against the clay. If the clay sticks to the thumb it is said to have some binding value, while if it does not it is safe to assume that it has none.

Ottawa Engineers View Lighthouse and Fog Alarm Apparatus

The Ottawa Branch of the Canadian Society of Civil Engineers held a special meeting on September 7 at 8 p.m., in Machinery Building, Lansdowne Park, to inspect the exhibit of lighthouse and fog alarm apparatus arranged by the Department of Marine. Lieut.-Col. W. P. Anderson, C.M.G., M.Inst.C.E., M.Can.Soc.C.E., gave a short address on the optical and accoustic principles illustrated, and the apparatus was explained by Mr. F. P. Jennings, A.M.Inst.C.E., A.M.Can.Soc.C.E. Through the courtesy of the management of the Central Canada Exhibition Association, entrance to the grounds of the exhibition was free on the evening in question.

Officers of Ontario Municipal Association

The following officers were elected for the ensuing year at the recent convention of the Ontario Municipal Association in Toronto:

President—S. H. Kent, City Clerk, Hamilton; Vice-Presidents—G. H. Dewey, Brockville; E. M. Young, Picton; Mayor Burgoyne, St. Catharines; A. Ferland, Cobalt; S. Baker, London; W. H. Nugent.

Executive—Ald. McGrath, Ottawa; Chas. R. Tuson, Windsor; K. W. McKay, St. Thomas; T. J. Moore, Guelph; Wm. Johnston, Toronto; M. Huenengarde, Kitchener; F. R. Waddell, Hamilton; W. B. Doherty, St. Thomas; Ald. Parks, Belleville; M. D. Holmes, Leeds; J. James, Fort William; Ald. Dickinson, Wentworth.

Government of Chile Asking Bids for Port Improvement

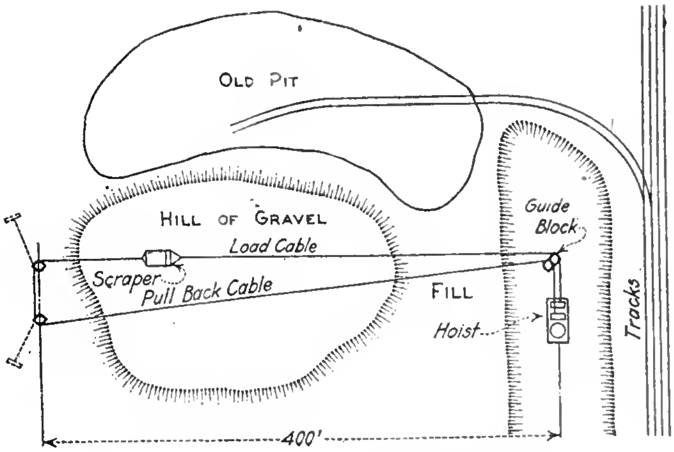
The Government of Chile will expend $8,500,000 in the improvement of Antofagasta, the principal port for the export of sodium nitrate. Chile's nitrate business has grown greatly because of the war's cutting off the German supply from other nations, and also because the manufacture of munitions has increased the demand for saltpetre. One of the objects of Antofagasta improvement is to equip Chile to hold this greater nitrate business after the war is over. Bids have been asked of American contractors for the construction of the waterfront improvements, as well as bids for taking up the loan the government will make to finance the undertaking.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Bottomless Bucket Strips Overburden from Gravel Pit

AN improved method of removing the overburden from a hill to get at the sand and gravel underneath, employed by the Diamond Sand & Gravel Company, at Bedford, Ohio, is described in Engineering and Contracting. The top of the fill is being scraped off and deposited in a ravine at one end of the hill. The accompanying sketch shows the layout of the installation.



How overburden was stripped from sand and gravel pit.

The scraper is a 1-yard Sauerman bottomless power scraper operated by a 90-h.p. Thomas electric hoist, which is set up on high ground across the ravine. The hoist is a type specially designed for scraper work, the rear drum operating the "pull-back" cable having a speed three times as great as the front drum. The machine requires one operator and a rigger stationed at the guide blocks to make the necessary shifts in the line of operation. This outfit installed represents an investment of about $5,000.

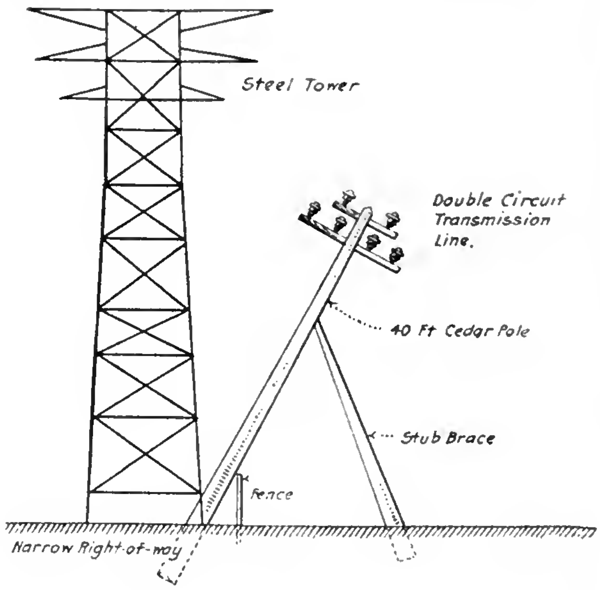
The top soil of the hill is largely clay and runs from nothing to 6 feet in depth. Hard "shoulders" of clay, when encountered, are removed by "sawing" the scraper back and forth over the obstruction. A day's output will fluctuate between 200 and 300 yards, depending on the nature of the material.

Leaks in Masonry Wall Stopped with Cinders Sawdust and Manure

IN widening the Louisville & Portland Canal at Louisville, Ky., the old canal wall formed part of the cofferdam. The wall was of stone masonry and had a considerable number of open joints and deep holes, through which much water entered the pit. The minor leaks through the wall were stopped by causing a mixture of fine cinders, sawdust and manure to be drawn into the open joints from the canal side of the wall. This material was placed in a small wooden box with one side open and the bottom perforated. The open side of the box was held against the canal side of the wall, causing the water to flow through joints. The depth to which the box was submerged was determined by locating the inflow of water from the rear of the wall. A foreman and six men were detailed to attend to this work. The success attained in preventing leakage by this method was such that during ordinary river stages one 12-inch centrifugal pump kept the pit unwatered.

Stub Poles Enable Erection of Steel Towers on Narrow Right of Way

IN reconstructing about 0.5 miles (0.8 km.) of transmission line in which wooden poles were replaced by steel towers, a Middle Western company wished to set the towers in practically the same alignment as that already occupied by the poles. It was at the same time important that service be maintained on the pole line while the new work was going on. Obviously this could not be accomplished if the towers were swung up into the overhead lines. Since the right-of-way at this point was narrow, permission was obtained to set stub poles temporarily on adjoining land. The upper part of the wooden pole line was then leaned over by digging out behind the butts of the poles and pulling them down until they touched the upper ends of supporting braces. The line was operated in this fashion until the work was finished. The illustration, from the Electrical World, shows how the problem was solved.



Leaning wooden poles permits maintenance of service during erection of steel towers.

Reconstruction of French Military Roads

In reconstructing French roads for military purposes, where they have not been damaged by war operations, it is sometimes possible to afford considerable relief to traffic by widening them. In carrying on the work in mountainous sections subject to heavy rainfall, where it is necessary to have the surface dry out as quickly as possible, the roads are sometimes given considerable crown, to shed the water into the ditches. This crown causes much complaint from drivers, for it results in considerable skidding, but the transportation authorities believe it is better to dry off the road promptly, even at the loss of a few trucks by accident, than to have it stay soft, damp and easily cut up for some time after each rainfall. Another interesting feature in the improvement of these roads is seen at some of the little hamlets where the roadway is confined between houses, so that widening of it is impracticable. Here detours are built around the hamlets, sometimes narrow so as to take only the traffic passing one way, and sometimes wide enough for traffic in both directions. There are some of these narrow roads which it is impracticable to widen rapidly, and in such cases traffic in one direction is routed over them and a new road built to accommodate the traffic in the other direction. It has also been necessary in places where narrow bridges would cause a congestion of traffic on a wide road, to widen the bridge or build another beside it. Some of these bridges are by no means so strong as might be desired for concentrated military traffic and the ways in which they are cribbed and braced include every expedient engineering ingenuity can suggest.—Engineering News-Record.

A New Type of Self-Feeding Bucket Loader Reduces Labor Requirements

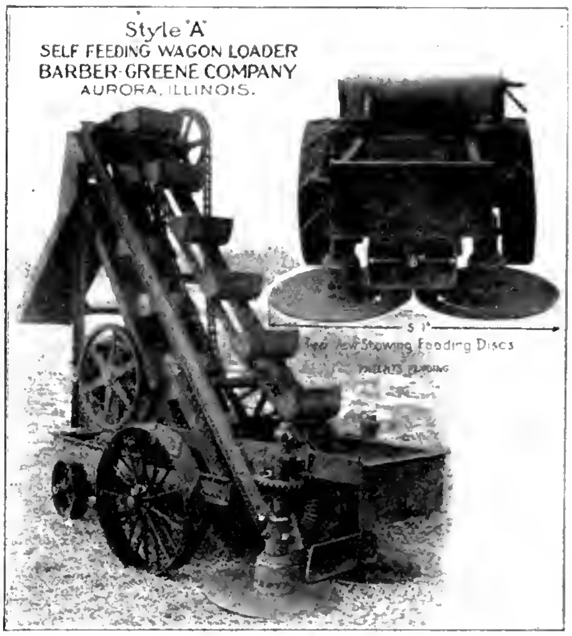
A new type of bucket loader is being used with very successful results in the plant of the Wabash Portland Cement Company at Stroh, Ind. It is claimed that this loader is equal in performance to a light steam shovel or locomotive crane in many classes of work.

The light wagon loader has become definitely established in the past few years, and the new "B-G" bucket loader is a development of this equipment. Its distinguishing feature is a digging device which digs to a width of five feet, cutting under the pile of material and making a swath in advance of the traction wheels. This mechanism eliminates all labor required in shoveling to the buckets, so that one operator alone can keep the machine continuously up to the capacity.

The digging device consists of a pair of horizontal revolving discs set almost flat on the ground, but with a slight pitch toward the pile. The rotation of the two discs carries the material to the centre, where it is picked up by the buckets digging from the hard surface of the discs. The wide digging face of this loader enables it to handle a large quantity of material with very little movement of the machine, and it also enables the machine to advance into the pile without obstruction. This loader, together with a small car system, is doing the work usually required of an elaborate conveying system, and is enabling three men to replace a force of fourteen.

In general use a machine of this type has a large field to serve—in the larger retail coal yards and at power plants or mines where coal is stored in piles, in contracting service for loading stone, sand, or gravel—in fact, wherever bulk material of almost any character must be handled in quantities from open piles to wagons, trucks, or cars.

The general construction of this loader further adapts it for the heaviest service, as the design of the



Self-feeding bucket loader.

frame and the selection of the chain and buckets and other parts was made from the standpoint of strength and wear. This loader is self-propelled—forward and reverse—all movements being controlled by friction clutches. It was developed and is being manufactured by Barber-Greene Company, of Aurora, Ill.

Two Norwegian engineers have patented a method of smelting poor grades of iron ore by electricity. First-class steel at a low cost and with less fuel, is claimed.

New Books

Operation and Maintenance of Irrigation Systems—by S. T. Harding, assistant professor of irrigation, University of California, formerly irrigation engineer, United States Department of Agriculture; McGraw-Hill Book Company, Inc., New York, publishers; price, $2.50; 266 pages, well illustrated; size, 6 x 9 in.; bound in blue cloth. This volume is the outgrowth of notes prepared for class use in a course in this subject given by the author at the University of California. It is based on several years' personal experience and observation in irrigation work in many of the Western states and on careful examination of available published material, supplemented by correspondence and discussion with many of those connected with the operation and maintenance of irrigation systems. The scope of the work may be judged from the following chapter headings: General maintenance; maintenance of irrigation systems; organization for operation and maintenance; methods of delivering irrigation water; measurement of irrigation water rules and regulations; payment for construction and operation charges; general operation; operation and maintenance accounts. An appendix gives rules and regulations in force in various districts in the United States.

Three million dollars has been voted by the Dominion Government for the completion of the work on the Hudson Bay Railway.

Mainly Constructional

East and West—From Coast to Coast

In the government supplementary estimates $51,000 is voted for harbor work at Goderich, Ont.

A recent fire in Blairmore, Alta., wiped out practically the whole business section of the town.

A recent fire at Estuary, Sask., destroyed the greater portion of the town, causing a loss estimated at about $400,000.

If nothing happens to upset present arrangements, it is the intention to put the centre span of the Quebec bridge in place on September 17.

The Dominion Bridge Company, Lachine, P.Q., are equipping a portion of their plant for the manufacture of marine engines and boilers.

It is proposed to erect in Orillia, Ont., a hospital for returned soldiers, at a cost of $50,000. This amount is being subscribed by the townspeople.

Notice has been given of the winding-up of the Woodstock Concrete Machinery Company, Ltd., of Woodstock, Ont., and the appointing of a liquidator.

It is reported that a sanitarium for the Military Hospitals Commission will be erected at Ste. Anne de la Pocatiere, Que., to cost in the neighborhood of $300,000.

A building by-law has been prepared for the town of Campbellton, N.B., by Mr. Brodie, architect, and has come before the by-laws committee for consideration.

Hon. J. D. Hazen, Minister of Marine and Fisheries, has definitely rejected a request to grant a bonus of $20 a ton on shipbuilding in Canada for the next fifteen years.

The Grand Trunk Railway Company and the Council of Orillia, Ont., have agreed upon plans for a new station in that town, to replace the one recently burned down.

The city of Toronto is apparently suffering from a shortage of housing accommodation. It is stated the population is steadily increasing, while the high cost of materials and labor is holding back building work.

Work on the sewage farm at Kitchener, Ont., has been delayed somewhat owing to scarcity of labor, but it will probably be completed within a few weeks. Mr. Willis Chipman, of Toronto, is the consulting engineer.

The municipal councils of the city of Sault Ste. Marie, Ont., and the town of Steelton have approved an agreement providing for the amalgamation of these two municipalities. A by-law will be submitted for the approval of the ratepayers.

The City Council of Quebec recently voted the sum of $6,000 asked by the Health Committee to carry on the work of purifying the city's water supply. It is necessary to improve conditions at the source of supply in the St. Charles River.

The government bridge over the North River, on the 6th Concession of North Orillia, Ont., about a mile east of Uhthoff C.P.R. station, has been completed. It is a reinforced concrete trestle structure, and stands on 16 concrete piles, driven to the rock.

Building permits issued in Welland, Ont., during the month of August are valued at $11,115, as compared with $25,648 in the same month last year. The total for the first eight months of the year is $183,380, while in the corresponding period last year it was $146,293.

J. Coughlan & Sons, of Vancouver, are constructing six steel steamers of 88,000 dead-weight tons capacity. These vessels are 425 feet long, 54 feet beam, and 29.2 feet moulded depth. They are turbine-driven, with Scotch boilers, built at the company's own shops in Vancouver.

An appropriation of $12,000 for use this year in improving the highways of Kent County, Ont., is requested by Superintendent L. A. Pardo, and the Good Roads Committee will make a recommendation to the County Council at the next meeting that this amount be granted.

Work has recently been commenced on a new concrete bridge over the Rouge River at Locust Hill, Ont., for the York Highway Board. The work of cutting down the grade on the approaches was also started, and it is expected that the bridge will be ready for traffic by December 1.

No camp of the engineering students of the University of New Brunswick is being held this autumn, for the first time in almost twenty years. This state of affairs is directly attributable to the war, young men who, under normal circumstances, would be at college, being in the army.

Building work in the city of Moncton, N.B., is reported quite active. Up till the end of August this year there were 98 building permits issued, and since January over 70 new buildings have been commenced. It is towards the northwest corner that the growth of the city is most noticeable.

The ratepayers of Port Dover, Ont., have voted an appropriation of $65,000 for the installation of a gravity system of waterworks, with a high-pressure tank for fire purposes. The work is not to proceed until after the war. The water supply is to be taken from springs about two miles up the Valley of Lynn.

The town of Dartmouth, N.S., is looking forward to the establishment of a shipbuilding plant in the near future, and the Town Council and Board of Trade, at a recent meeting, voted a bonus of $200,000 to any responsible firm locating at that point. The site proposed is at Tuft's Cove, to the north of the town, within the limits.

The water systems of Kitchener, and Waterloo, Ont., have now been connected up. A concrete pit was completed a short time ago and a meter and check valve installed. An electric valve was also installed. This new work will enable Kitchener to use Waterloo water by means of operating the electric valve from either office.

The foundations have been completed and work has just been started on the erection of the bins for the new annex to the Quebec Harbor Commission grain elevator. This annex is to have in all about 110 bins, with a total capacity of 1,000,000 bushels, thus bringing up the capacity of the elevator to 2,000,000. Mr. George A. Fuller, of Montreal, is the contractor.

It is reported from Trenton, Ont., that at least twenty new houses are required for the heads of departments of the new British chemical plant now being erected in that town. This fact has been brought to the attention of the Town Council and Board of Trade, and it was stated that, unless accommodation was provided, the officials would have to seek homes elsewhere, probably in Belleville.

Building permits in the city of London, Ont., show a drop in the month of August this year as compared with the same month last year. The figures for these months are 67 permits, valued at $31,255, and 106 permits, valued at $107,985 respectively. The total for the first eight months of the year is 598 permits, at a value of $515,435, as against 740 permits, valued at $692,715 in the corresponding period in 1916.

A. E. Ponsford, St. Thomas, has been awarded the contract for the erection of five buildings which will form an addition to the plant of the Maple Leaf Harvest Tool Company, at Tillsonburg, Ont. The cost is $50,000, and the work is to be completed within three months. The buildings will be of red pressed brick, concrete, and steel, and will be one storey in height. The sizes are 50 x 60, 50 x 140, 50 x 90, 50 x 90, and 100 x 130.

According to the statement of a well-known financier, the Province of British Columbia is now in a prosperous condition and everywhere showing signs of industrial activity and expanse. "The shipbuilding industry," he states, "was at the bottom of the industrial revival in the Pacific Province. The enormous contracts given for timber to be used in the construction of the new boats set the lumber mills all going again, and gradually other industries were benefited."

The work on the new C.P.R. tracks, from the North Toronto station to Leaside, is making favorable progress, although there are some difficulties on account of labor shortage. A start on the concrete footings for the towers on the new bridge to be erected in place of the present Reservoir Bridge has now been made. It is anticipated that the temporary wooden trestle will be ready for operation shortly. At the old Belt Line bridge the temporary trestles have been completed, and the work of taking down the old bridge will proceed.

The Ontario Railway and Municipal Board have approved the city of Toronto's plans for the proposed extension of the Bloor Street car line, from Quebec Avenue to Runnymede. These provide for a single-track line with one 60-foot turnout siding, just west of Clendennan Avenue. Being intended merely as a temporary makeshift, the line will be built close to the north side of the street, to permit work being carried on without interference to traffic when the city is able to get the materials for the permanent double track to be laid in the centre of the roadway.

R. C. Hoffman, contractor, recently started work on the excavation for the laying of a 24-inch water main along Eglinton Ave. west to Weston Road, in York Township, Ont. Along the road where operations are at present under way a corduroy road, of cedar logs, was laid some thirty or forty years ago by settlers. It is still in a good state of preservation, and much labor is involved in tearing it up. To compensate for the shortage of labor, machinery will be employed, including a 37-ton excavator, which can dig a trench approximately 20 feet deep and 500 feet long in one day; also a filling-in machine and a caulking machine. Nearly three miles of road are to be excavated in all.

It appears to be definitely settled that a big concentrating mill for the Sullivan ore is to be established by the Consolidated Company near Marysville, B.C., and not at Kimberley, as was expected. This will lessen the concentrating expenses at the Trail works of the company, where the capacity has been somewhat strained, and also reduce shipping costs. For the purposes of the new mill a pipe line will be put in, starting from a point near the compressor plant above Kimberley and carried down along the hillside above the C. P.R. tracks to a point on the old Hogan Limit, about a mile above Marysville. Here the Consolidated Company has secured a mill site of 20 acres, and at this point it is said they will have a head for their water of 400 feet.

Plans for the erection of the United States Steel Corporation's $20,000,000 plant at Ojibway, Ont., will now be proceeded with, according to the statement of Mr. Ward B. Perley, vice-president and general manager of the Canadian Steel Corporation, the Canadian subsidiary of the United States concern. This company was incorporated about three years ago, and a tract of land on the St. Clair River, north of Windsor, was purchased, where a separate municipality was established and streets laid out for an ideal town such as the United States corporation has at its American plant. The war temporarily halted the undertaking, but the invitation of tenders for the construction of a slip and concrete docks at Ojibway foreshadows further operations. The establishment of this new concern, with its powerful financial backing, will probably create keen competition in the Canadian steel industry.

At a recent meeting of land-owners interested in the dyking scheme at Sumas, B.C., and the reclamation of Sumas Lake, the former dyking commissioners resigned, in compliance with the request of the Provincial Government and the new Provincial Land Board, is to carry on the work according to existing plans. A petition, which must be signed by a majority in value of the owners of lands in the Sumas dyking district, and which was presented at the meeting, sets forth that the petitioners are desirous of having the land reclaimed and improved by drainage and dyking by the execution of certain works. The work calls for the necessary dykes, ditches, and pumping devices as described in existing plans, with such modifications or improvements as engineers may recommend. The area affected covers 30,000 acres, of which 9,500 are in the bed of Sumas Lake.

Personals

Capt. Alex. C. Lewis, formerly secretary of the Toronto Harbor Commission, is reported wounded in a recent casualty list.

Mr. Charles F. Gibson, former town engineer of Bowmanville, who left some time ago for the West, reached Vancouver recently, and will probably locate there.

Mr. G. M. Wilson, assistant master mechanic, has been appointed master mechanic of the Grand Trunk shops at Montreal, in place of Mr. A. A. Maver, who has resigned.

Mr. E. R. Battley, general foreman of the G.T.R. motive power department at Deering, Me., has been promoted to the position of master mechanic of Eastern lines, with headquarters at Montreal.

Mr. J. V. T. May, ex-alderman of the city of Toronto, has been appointed building superintendent by a syndicate which proposes to erect a number of apartment houses in Toronto, Hamilton, London, and other Ontario cities.

Mr. J. K. McNeillie, general superintendent of the Canadian Government Railways, Moncton, N.B., has resigned, accepting a position on the Delaware and Hudson Railway, under F. P. Gutelius, formerly manager of the C.G.R.

Mr. H. A. Woods, M.C.S.C.E., assistant chief engineer of the Grand Trunk Pacific, Winnipeg, has resigned. He was associated with Mr. H. H. Kelliher in the building of the system, and was connected with the Grand Trunk and Grand Trunk Pacific for fifteen years.

Mr. W. H. Sample has been appointed superintendent of motive power of the Grand Trunk Railway, with headquarters in Montreal. Mr. Sample first became associated with the Grand Trunk when he was appointed master mechanic on the Ottawa division in 1911. He was transferred to the Western lines in 1914 and to the Eastern lines in 1916, holding the same position.

Mr. E. Jordan, Toronto, has been appointed general manager and chief engineer of L'Air Liquide Society, in succession to Mr. E. Royer, who resigned to go in business on his own account in Montreal. Mr. Jordan recently came to Canada from France, but had previously visited Canada. The company are building a new factory at Halifax and an addition to their plant in Toronto. The head office is in Maisonneuve, Que.

Obituary

Sergeant Robert H. Duff, formerly resident engineer of the C.P.R. at Chapleau, Ont., is reported killed in action. He went overseas in July, 1916, and had been in France since March last. He was born in Bridgewater, N.S., 29 years ago.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Annapolis Royal, N.S.
Town council contemplate construction of dam at Grand Lake. Plans submitted by the engineers, Booker & McKechnie, Davidson Bldg., Halifax. Spillway of 100 ft., dam 25 ft. deep.

Beauceville, Que.
Plans and specifications with the secretary-treasurer, P. C. Fortin, who will receive tenders until Sept. 15 for the construction of concrete sidewalks for the Municipal Council.

Chatham Township, Ont.
Tenders close with the Commissioner, Wm. Biden, R. R. No. 3, Wallaceburg, Ont., on Sept. 15 for pumphouse and equipment. Plans with commissioner and clerk, A. McArthur, Tupperville, Ont.

Ekfrid Township, Ont.
Tenders are being received by the chairman, Frank Nichols, Appin P.O., until Sept. 15 for repairs to Macdonald drain, 90 rods of tile, and 280 rods open drain for the Township Council.

Lethbridge, Alta.
The extension of water system from Lethbridge to Hardieville is contemplated by the councils of these towns. Cost about $15,000.

York Township, Ont.
York Township council has had plans prepared for 6-inch water main on Glenholme Ave., estimated cost $9,599, also 12-inch cast iron main on St. Johns Road, from Runnymede to Langmuir, estimated cost $18,081.

CONTRACTS AWARDED

Shawinigan Falls, Que.
Napoleon Lapointe has the general contract for laying of sidewalks on Rue du Coton for the town council, and will require 400 bags of cement. Town engineer, Raould Reinfret.

The town council has let the contract for grading work for proposed concrete highway, to J. D. Jacob. Concrete work to be done next spring. Mr. Jacob also has contract for grading for a macadam road.

Woodstock, N.B.
The town council have let contract for filtration plant to the New York Continental Jewel Filtration Co., New York City, at $64,948, and contract for repairs to pumping station to Fraser & Chalmers of Canada, Limited, 285 Beaver Hall Hill, Montreal, at $25,000. Engineer, A. K. Grimmer, St. Andrews, N.B.

Railroads, Bridges and Wharves

Bruce Township, Ont.
Township Council contemplate erection of bridges, to cost $15,000, to replace structures damaged in floods. Clerk, J. G. MacKay, Underwood, Ont.

Norwood, Ont.
Village Council will erect bridge, and alternative tenders are being received by the engineers, Bowman & Connor, 31 Queen W., Toronto, closing Sept. 14, for a 40-foot steel bridge superstructure or for a concrete arch truss bridge. Plans with engineers.

CONTRACTS AWARDED

Grand Falls, N.B.
Provincial government department of public works, Fredericton, N.B., has awarded the general contract for embankment and concrete arch to F. L. Boone, Devon, N.B.

Kincardine, Ont.
The Hunter Bridge & Boiler Company, Queen St., has been awarded the contract for the following bridge for the town council: 50 ft. cement arch on Broadway, 50 ft. cement arch on Durham St., and class "A" 50 ft. steel structure on Russell St.

Sydenham Township, Ont.
Mr. Corbett, care of the township clerk, J. M. Thompson, Bognor, Ont., has been awarded the general contract for erection of a steel bridge for the township council.

Tansley, Ont.
Norman McLeod, Ltd., Kent Building, Toronto, has the general contract for concrete and steel bridge, costing $60,000, for the Halton County Council.

Three Rivers, Que.
City council has let general contract for crib work and filling from aqueduct to highway bridge abutment to Charles Page, at $12,000. Spikes and bolts will be required by general contractor.

Public Buildings, Churches and Schools

Byron, Ont.
The Military Hospitals Commission, Ottawa, officer in charge, Capt. Symes, is receiving tenders after Sept. 15 for $10,000 school for soldiers. Architects, Watt & Blackwell, Bank of Toronto Building, London.

London, Ont.
Tenders are open for hospital for the Salvation Army, to cost $25,000. Chairman of building commission, Ensign Martin. Architect, Brig. D. Miller, Albert St., Toronto. White brick construction.

Port Credit, Ont.
Ratepayers have requested the Town Council to erect new town hall. Clerk, F. W. Ott.

Spirit River, Alta.
Spirit River Public School Board have had plans drawn for a school. Architect, A. M. Jeffers, McLeod Block, Edmonton. ton.

Toronto, Ont.
Plans for Weston Road Baptist Church have been revised and new tenders are now being received by the architects, Burke, Horwood & White, Ryrie Building.

Weston, Ont.
Town Council contemplate erecting school. Clerk, J. F. Taylor.

CONTRACTS AWARDED

Gravelburg, Sask.
Hastings & Willoughby, 1719 Cornwall St., Regina, have the roofing contract for boys' and girls' convent, costing $100,000, for Les Religieuse de Jesus Marie.

Halifax, N.S.
Russell & Macaulay, St. Paul Building, have been awarded contract in connection with erection of church for St. John's Presbyterian congregation, at $19,000. Original project for $50,000 not to be carried out meantime.

Kentville, N.S.
C. H. Wright, Wolfville, N.S., has been awarded the contract for erection of infirmary and vocational building for returned soldiers by the Provincial Government, at $75,000.

Marieville, Que.
A. & D. Boileau, 546 Fabre St., Montreal, have the general contract for erection of church for parish of Ste. Marie de Monoir. Architects, Viau & Venne, 76 St. Gabriel, Montreal.

Montreal, Que.
Caron & Surprenant, 464 La Salle Avenue, Maisonneuve, have the general contract for alterations to heating system for St. Paul School for the Roman Catholic School Commissioners, 87 St. Catherine St. W.

North Lakeland, Man.
Tenders being called for school for the Municipal Council. Secretary-treasurer, Stuart L. Bolt, Addington P.O., via Portage La Praire, Man. Plans and specifications with municipal office, Gladstone, Man.

Outlook, Sask.
The following contracts have been been awarded in connection with the erection of a $10,000 college building for the Saskatchewan Norwegian Lutheran College Association: Masonry, Alex. Young, Fourth and Angus Streets, Regina; steel, Dominion Bridge Company, Ltd., Canada Building, Winnipeg; carpntry and roofing, general contractors, Poole Construction Company, 1 Saskatchewan Co-operative Building, Regina; electrical work, Northwestern Electric, Ltd., 107 Kerr Block, Regina; plumbing and heating, Alexandra & Baird, 48 Fairford E., Moose Jaw, Sask.; painting, F. M. Crapper, Lorne and Eleventh Streets, Regina.

Quebec, Que.
Contract for excavation and concrete

ESTABLISHED 1886

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Principal Contents

Page

Selling a Contractor's Services

IN this issue is the concluding article of a series of three which are of more than passing interest, in that they throw light on a matter concerning which little has been published—the methods that contractors might pursue in obtaining business. A construction concern, in searching for work, is seeking to sell a building or the services requisite to the construction of a building, and, as in almost any other selling proposition, there are certain methods to follow if effective results are desired. Salesmanship that must be practical and intensive is the mainstay of the systems recommended in each of the three articles. The need of salesmanship is especially obvious where a contract is on the cost plus percentage or fixed sum plan. The growing realization of the benefits of such a scheme is increasing the necessity for construction firms to use sales efforts. Two of the authors, however, emphasize the importance of the selling element, even where a lump sum contract with competitive bidding is concerned. There is a possibility of selling a construction company's services in spite of a lower bid. To the man who is open to have a first-class building in spite of cost, a firm's experience and reputation, properly emphasized by forceful sales arguments, may appeal more than the lower bid of a competitor.

The recognized superiority, however, of the cost plus form of contract is putting the price alone more and more in the background. As this purely mercenary viewpoint is being lost, there is a better opportunity for contractors to develop the intensive salesmanship methods that will be factors in closing out contracts.

Continual hammering appears to be the process that increases business. Contractors must follow their prospects at their very heels and drive home every possible selling argument. Energetic and extensive advertising of every sort adds emphasis to personal sales efforts. These of themselves, however, are ineffective if there are not organization and reputation behind them. A construction organization must be perfected so that it can and does do what is claimed for it. A highly-organized concern, with men thoroughly tried out in the organization, will win contracts on its own merits. Reputation for honest work and square deals will outweigh, in many cases, the most skillfully-played sales arguments. A firm's standing has often brought new, unsolicited work, and it is the best possible booster. In short, then, the secret of the successful selling of a construction company's service is, in the words of W. P. Anderson, "to first build up an efficient organization, obtain a high reputation for honesty, engineering ability, fair dealing, speed, and good work, and then convince prospective clients of these facts and the advantages of having this kind of a contractor do his work."

Construction Work in British Columbia

THE rapid pre-war development throughout the Dominion, which was so suddenly checked by the outbreak of hostilities, seems in many parts of the country to be regaining a normal condition. This is particularly noticeable in the province of British Columbia, where considerable industrial activity is apparent. The building situation has improved greatly, and it is estimated that the value of construction work for which contracts have been let and work is under way, it about $12,500,000. The bulk of this amount is being expended on commercial and industrial building, there being apparently very little work of a residential character under way.

Railway and Waterway Improvements

In Vancouver, railway and shipping developments constitute the most important new work. The Canadian Northern Railway's new depot and terminal at False Creek is costing $1,000,000—approximately the same amount as spent on the Great Northern Railway's buildings and trackage, also at False Creek. Dredging work by the government in this locality has required an expenditure of about $700,000, and the Canadian Northern Railway are building a sea wall at a cost of another hundred thousand. The Coughlan Shipyards and the Western Canada Shipyards are also establishing plants at False Creek, and the government is building a turning basin at a cost of $100,000. Among other buildings under way is a new sawmill on Sixth Ave. for the Alberta Lumber Company, costing $100,000, also a

$50,000 cold-storage plant for the Canadian Fishing Company at the foot of Gore Ave. City work includes two trunk sewers—one in Stanley Park and another in Hastings Park, each costing $300,000. The new coal harbor causeway involves an outlay of $50,000, and dredging in the same location, $17,000 more. One of the most important waterfront developments is the extension to one of the Canadian Pacific Railway piers. This is costing $650,000, and in addition there is considerable dredging work around the pier and along the wharves in the immediate vicinity. Other work which may be mentioned is the alterations to buildings of the University of British Columbia and the erection of three new ones. Some stores are being remodelled and added to, and a new apartment house is being built in the city.

Three Millions for Harbor Work

The most important construction work at Victoria is in connection with the harbor improvements. Two million dollars are being expended on the new government piers, and one million on the breakwater. Work in the city includes the new store of the Hudson Bay Company, costing $700,000; Columbia Methodist Church, $20,000; new city school at Hollywood, $44,000. There are a number of residences in process of erection, and some alterations and extensions are also being carried out.

The following are some of the most important undertakings being carried out in other parts of the province: dam and mills of the Tonopah-Belmont Co. at Princess Royal Island, $1,000,000; government dredging and construction of jetty at north arm of Fraser River, $755,000; mills, wharves, etc., of the Pacific Mills at Ocean Falls, $750,000; concentrator at Surf Inlet for the Surf Inlet Power Co., $500,000. The Dominion Government has also let the contract for a second unit of the Fraser River jetty at a cost of $300,000. There are various other less important projects in the different cities and towns, including: a hotel at Prince George, $25,000; power house at Kamloops; government building, $30,000, and high school, $20,000, at Fort Alberni; factory of Morrison Steel & Wire Co. on Lulu Island, $25,000. Many more buildings of this nature are being erected, as well as a number of stores and residences.

Projects Being Contemplated

A considerable quantity of construction work is also contemplated. In the city of Vancouver there is an additional pier for the C. P. R., on which, it is announced, work will be commenced as soon as the extension to pier "D," now in progress, is completed. The government harbor works at the Kitsilano Indian Reserve will involve an outlay of several millions, but work has been delayed owing to the original arbitration findings being rejected and will likely not be started for some time to come. There is also the Dominion government armory to be built in Grandview, at a cost of $350,000. A number of other large undertakings are proposed at Vancouver, but it is not probable that work will be commenced on any of them until after the war. These include: bridge over the Second Narrows to cost $1,750,000; pleasure pier for English Bay, $250,000; Canadian Northern Hotel, $1,000,000 (likely to be postponed as long as possible); two new post office buildings planned by the Dominion government, and extension to the court house by provincial government, total cost about $600,000; factory, Royal Crown Soap Works.

Proposed new work in Victoria will involve more than $3,000,000. Plans are now being prepared by the Canadian Pacific and Canadian Northern Railways for a $1,000,000 union station. The C. P. R. also intends to build a pier at an equal expenditure, but they will not start work for some time. Another big project is a million-dollar steel bridge which the city is planning. Other proposed work in Victoria includes: ten-storey office building for British Columbia Electric Railway; $400,000 cathedral for Christ Church congregation; school buildings to cost about $50,000.

Useful Map Issued by Department of the Interior

A publication which should prove of considerable interest to the prospective settler to Western Canada has just been issued by the Natural Resources Intelligence Branch of the Department of the Interior. It is known as the "Homestead" map, and shows graphically the exact location of each quarter-section which is still available for entry under the free Government offer of 160 acres. The map has been published in four separate sheets, one each for Manitoba, Saskatchewan, Northern and Southern Alberta, respectively, and is available for free distribution in individual sheets or in complete sets. The Homestead map is one of a number of maps, reports and bulletins with respect to settlement in Western Canada that are available for free distribution upon application to the Natural Resources Intelligence Branch. In view of the arrangement with respect to farm labor in Western Canada counting as residence on a homestead and thereby reducing the period within which residence and cultivation duties must be performed prior to applying for a title to the land; also on account of the impetus which has been given to agriculture by the present world shortage of foodstuffs, the demand for information on the subject of homesteading is showing a marked increase.

Office Buildings Used as Apartments in Saskatoon

There is practically no residence construction being carried out in Saskatoon, Sask., at the present time. A shortage of housing accommodation would naturally result upon the arrival of the large number of people who come to reside in the city for the winter months, were it not for the fact that there are many large apartment blocks in the city which are brought into use. Many of these blocks were originally intended for office buildings, having been erected at the time of the boom. However, when the slump came and the value of city property dropped tenants for office space were not available. As a result the owners of these blocks in the great majority of cases rented their rooms for domestic accommodation and have thus obtained a certain profit on their investment. This action involves an infringement of a city by-law as the office buildings are not equipped with the plumbing fixtures specified for apartment houses, but in view of the convenience to the public, it is stated that the city officials do not desire to take any action.

A new method of clearing waterways of vegetable matter consists of a set of mowing machines attached to the stern of a launch. It is the invention of a Frenchman.

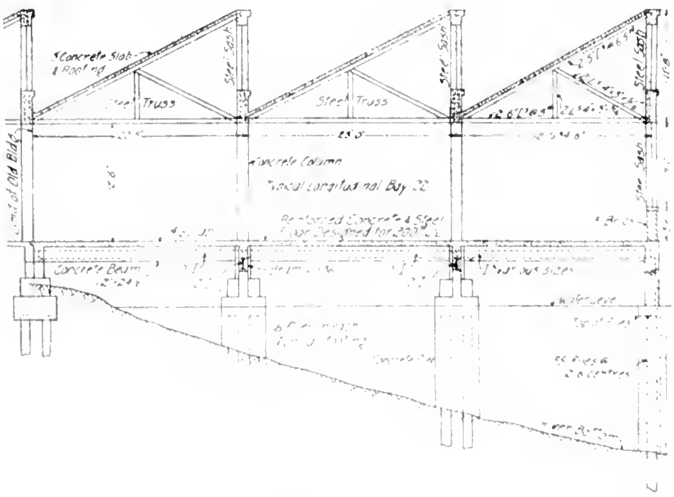
Unusual Features in Ford Machine Shop

Building 700 ft. by 70 ft. Built on Water Lot in Deep Water—840 ft. Retaining Wall Using Steel Sheet Piling as Temporary Forms—Form Work Carried on Steel Sections—Special Saw Tooth Roof

A NEW machine shop recently completed for the Ford Motor Company of Canada, at Ford, Ont., presents a number of unusual features. In the first place, the building, which is 700 ft. long and averages 70 ft. in width, was constructed on a water lot, where the depth of water was as much as 20 ft. On three sides of the shop an 840 ft. concrete retaining wall was built in 15 ft. to 20 ft. of water, between two walls of Lackawanna steel sheet piling, without unwatering the location. The steel piling, which acted as the sole form work for the wall, was withdrawn by a steam hammer and re-used about ten times. Owing to the absence of a firm foundation, steel I-beams were used to carry the form work for the superstructure. These sections were designed to form part of the reinforcing of the concrete floor beams. Another unusual feature was the adoption of a modified saw-tooth roof design, in which a vertical steel sash of the ordinary type was employed—a construction which obviates the leakage troubles of ordinary saw-tooth construction.

Built Over River

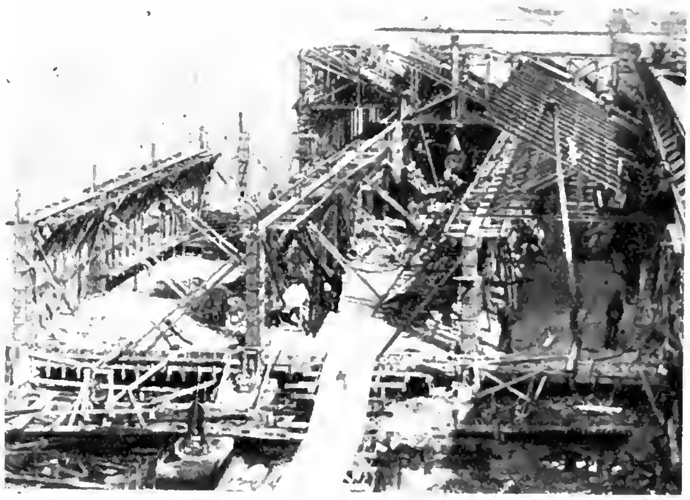
During the summer of 1916 the company applied to the Dominion Government for permission to extend their building out into the Detroit River to the limits of their water lot. The extension was to provide additional space for their machine shop. In order to have this extra space alongside their existing shop, which was essential to preserve the efficiency of the plant, it was necessary to build out over the river, as this was the only available location. The Dominion Govern-



Section of new shop. Building is carried on piers and long retaining wall which were constructed under water.

ment granted this permission on condition that a retaining wall the full length of the property be built to protect the channel of the river and the property further down stream. Accordingly, it was decided to build a concrete wall, supported on wooden piles, the concrete being carried to the bottom of the river. Although cheaper methods might have been used in the construction of this retaining wall, the company preferred one of solid concrete.

In building the retaining wall, a single row of 35 ft. wooden piles was first driven by a steam hammer, mounted on a scow. These piles were spaced at 2 ft. 6 in. centres, and, after driving, were cut off one foot



General construction view of Ford factory.

below the water line. Steel sheet piling of the Lackawanna type was then driven 18 in. on each side of the centre line of the piles, the two rows thus enclosing a space 3 ft. wide. Reinforcing bars at 3 ft. centres were hooked around the wooden piles in such a way as to form a continuous horizontal reinforcement. Vertical rods at 2 ft. centres were also used. When these bars were in place the concrete was poured through a long sheet metal tube or tremie to the bottom of the river. As the concrete rose the tube was drawn up, the end being always kept just below the surface of the concrete in the wall. In this way the concrete was poured without unwatering the space between the sheet piling.

Steel Piling Withdrawn and Re-used

No forms were used below water level except the steel sheet piling. After the concrete had been allowed to set for three or four days the sheet piling was drawn by an inverted steam hammer without difficulty and re-used. Although used about ten times, it was in excellent condition at the finish. The manufacturers of the piling were uncertain as to the possibility of its withdrawal without the use of wooden lagging to act as a form work for the concrete. However, the removal of the steel was accomplished very easily and without damage.

The entire space between this wall and the main factory building was to be covered with a one-storey, saw-tooth roof, machine shop. This space was 700 ft. in length, with an average width of 70 ft. It was found that it was impossible to obtain earth fill at any reasonable cost, and it was therefore decided to build the structure over the water, which was about 18 ft. deep at the outside of the lot. The method followed for this work was to drive piles for rectangular footings, encase these piles in concrete to the bottom of the river, and build a reinforced concrete floor, supported on these footings, which also carried the columns supporting the roof. Six wooden piles were driven for each footing, and the concrete was poured by tremie in wooden forms.

Steel Beams Carry Form Work

Since it was impossible to get a solid foundation on which to support the concrete forms, structural steel I-beams were used. These beams were designed strong enough to carry the dead load only, and were placed in such a position that, when the concrete was poured, the steel beams, together with such other reinforcing bars as were calculated to be necessary, formed the reinforcement of the concrete beams necessary to carry the total dead and live loads. There was no work done on these I-beams, since they simply rested on the concrete foundation piers as isolated beams. They were temporarily braced in position and the form work wired to

Concrete for piers and retaining wall was deposited under water by tremie method.

them. The completed form work held the beams rigidly in position, and the temporary bracing was then removed and the concrete poured. The floor slab is 4½ in. thick and designed for a live load of 200 pounds per square foot.

The roof was carried on light, simple, steel trusses, carried on reinforced concrete columns and beams. These steel trusses were placed at a convenient distance apart, with the bottom chords all on the same level, so as to carry shafting and motors with the least possible trouble and expense. The roof slab is concrete, 3 in. in thickness.

Vertical Sash in Saw-tooth Roof

Instead of using the usual saw-tooth roof construction, the glass in the saw-tooth was placed vertically. Ordinary steel sash was employed, with ventilators mechanically operated in units of convenient length. By this method it is necessary to make the sash only slightly larger in order to get practically the same amount of light as in ordinary construction. Leakage troubles, which are almost invariably associated with ordinary saw-tooth construction, are avoided in the vertically placed sash. Ventilation is also greatly facilitated by this method. This design was originally adopted in order to make use of old steel sash that had been on hand.

The building was designed and built complete by Wells & Gray, Ltd., of Toronto.

Montreal Aqueduct Report

Ratepaying Engineers Again Reply to Board of Engineers Emphasizing Uselessness of the Scheme

THE Committee of the Ratepaying Engineers of the City of Montreal have made a further reply to the reports of the Board of Engineers, as published in the Contract Record of August 29. This last report of the Committee of Ratepaying Engineers upholds their original contentions and emphasizes once more their belief in the folly of continuing the aqueduct power development. The report follows:

The documents (reports of Board of Engineers) have been studied by the committee, and, as a result, we desire to place ourselves on record in connection with certain of the points contained therein.

Without going into details, we may say that our conclusions are as follows, namely:

1. The annual operating cost of hydraulic development, Scheme II. of the Board of Engineers, is stated by the board to be the sum of $740,000. (Report of board, April 30, 1917.)

2. Under the present conditions of operation, and without considering the savings which would undoubtedly be made by using modern machinery and efficient operating methods, the annual costs of purchasing electric power, in accordance with the tender of the Civic Industrial and Investment Company, for pumping an average of 100,000,000 imperial gallons daily and providing for the requirements of the filtration plant, was unanimously determined by your Board of Engineers in consultation with Dr. L. A. Herdt, of McGill University, as the sum of $235,565. (Report of board, August 18, 1917.)

3. The total annual cost for the operation of the pump house at Atwater Avenue and of the filtration plant, for an average consumption of 100,000,000 imperial gallons per day, based on the purchase of power as above at $235,585, plus the annual charges on the money expended if hydraulic development be abandoned, is unanimously stated by your Board of Engineers to be the sum of $606,991. (Report of board, August 18, 1917.)

4. By the purchase of electric power the annual saving to the city when the average consumption will have reached 100,000,000 imperial galons daily will, therefore, be, on the above basis, the sum of $138,009.

5. The present average consumption of water is 54,625,462 imperial gallons per day. An average consumption of 100,000,000 imperial gallons will not be reached for at least ten years. Therefore, the annual savings above shown will be much greater until the average consumption reaches 100,000,000 imperial gallons daily. The total savings in the next ten years,

without considering the investment of the annual savings or compound interest, will be the sum of $1,830,000. If the power contract be made for forty years, as suggested, the total savings during the last thirty years of the contract, without considering interest or annual investment of the savings, will be the sum of $3,990,270. The total savings during the forty-year power contract, without annual investment of the savings or compound interest thereon, will, therefore, be $5,820,270.

6. The Board of Engineers have not included in their calculations of annual costs of operation of the hydraulic development any allowance for sinking fund and depreciation. If sinking fund and depreciation be taken into account, as they should be, the annual savings will be increased by the sum of $200,000, which, without annual investment or compound interest, will, at the end of forty years, amount to $8,000,000.

7. The purchase of power by the city at the present time, instead of completing the hydraulic development, Scheme II. of the Board of Engineers, will, therefore, represent a total saving in forty years, without annual investment of the saving or compound interest thereon, of the sum of $13,820,270.

8. Had the city purchased power before starting on the enlarged aqueduct power development it could have saved about $750,000 annually, as compared with Scheme II., and, without annual investment or compound interest, the total saving in forty years would have been $30,000,000.

9. If the annual savings be invested so as to yield 5 per cent., and be compounded annually in the ordinary way, the total savings in forty years, as stated in conclusions 5, 6, 7, and 8 above, will be practically trebled.

That the stupendous folly of the aqueduct power development is at once evident from the above figures is the conclusion derived by the Ratepaying Engineers. It is further urged that their solution be adopted without delay.

Ohio Method of Patching Bituminous Pavements

THE requirements of the Ohio State Highway Department for patching bituminous pavements as embodied in the new standard road specifications, are as follows:

The depression or area to be patched is thoroughly cleaned of all loose or matted dirt or foreign material and swept clean of all dust. When clean and dry, the depression is painted with the same kind of bituminous material as is used in preparing the bituminous concrete. When the depression is deeper than 3 inches, it is first filled to within 2 inches of the road surface with No. 2 stone (2½ in. to 1½ in.), which must be thoroughly tamped in place. The depression is then filled with bituminous concrete in sufficient quantity to fill the depression to the level of the surface of the surrounding pavement after the bituminous concrete is thoroughly compacted. The patch is covered with sufficient grit (material passing through a 1½-inch opening and retained on a No. 8 sieve) to prevent the bituminous material from sticking to the wheels of the roller and is then thoroughly compacted by rolling. The surface is finally covered with No. 6 grit (material passing ½-inch opening and retained on No. 8 sieve) or clean, coarse sand, to protect the patch while setting up.

The bituminous concrete is prepared by one of the two following methods, using the same kind of aggregate as was used in the original construction of the road; also same type of bituminous material as used in original construction, that is, either tar or asphalt.

When an asphalt bound road is to be patched, the bituminous concrete consists of a mixture of cut back asphalt and No. 4 size stone (material passing through a ¾-inch and retained on a ¼-inch opening) or slag in proportion of ⅝ to ⅞ gal. of bituminous material to 1 cubic foot of aggregate. The aggregates are thoroughly and uniformly mixed on a tight platform by hand methods or in a concrete mixer until each particle of stone is completely coated with the bituminous material. After mixing the bituminous concrete it is stored where it will be free from dust or dirt for 24 hours, or until the bituminous material stiffens sufficiently to bind when the patch is made. When required, a small amount of clean, coarse sand may be added to the aggregate.

A cold patch asphalt emulsion is sometimes used in place of the cut back asphalt. When the emulsion is used the proportions are 2/3 to 7/8 gal. to 1 cubic foot of stone chips. This mixture is used immediately after being mixed.

When a tar bound road is to be patched, the bituminous concrete consists of a mixture of tar and No. 4 size stone or slag in the proportion of ⅝ to ⅞ gal. of bituminous material to 1 cubic foot of stone. The aggregate is thoroughly and uniformly mixed on a tight platform by hand methods or in a concrete mixer until each particle of stone is completely coated with the bituminous material. After mixing, the bituminous concrete is stored, where it will be free from dust or dirt for several days until the bituminous mixture stiffens sufficiently to bind when the patch is made.

In either of the above methods the stone must be dry when mixed with the bituminous material and neither stone or bituminous material can have a temperature of less than 45 degs. F. when mixed together.

G.T.R. Planning New Station at Orillia, Ont.

THE Grand Trunk Railway Company have completed plans for a new station at Orillia, Ont., to replace the one burned down. The building will be 34 by 142 ft. and extensions at either end, measuring 22 by 34 ft. The foundations are to be concrete to the grade line, with a Longford stone base to the height of the sills (3 ft. 8½ in.). The superstructure will be of dark brown fire-flash Milton brick and a light mortar joint. The roof covering will be asbestos shingles, laid diagonally, the roof to project 6 ft. beyond the face of the wall, with Georgia pine rafter heels and sheeted soffit.

The street approach to the building is by a porte cochere, supported by brick and stone piers. The entrance doors, of a French pattern, will have divided lights on either side, there being plaster mullions between the divided lights and the door. In the station, near the street side, a small alcove, with a vaulted ceiling, will be built.

The side walls of the main waiting-room are to be divided into five ornamental plaster arches, with pilasters between. The plastering will be trowelled stucco finish, with white plaster moulds and ceiling beams. The floor is to be of terrazzo.

On one side of the main entrance there will be placed a ladies' rest room and toilet, and on the other side a men's smoking-room and toilet. The smoking and rest rooms are to be finished in Georgia pine, with burlap dado to a height of four feet, and the latter will be panelled with 3 in. strapping. These rooms will have French doors. The walls of the main waiting-room are to be covered with burlap to a height of four feet. Georgia pine is to be employed in the trim of the main waiting-room, while all woodwork is to be finished in bog oak. The lavatories are to be finished in Keen's cement, marked off in 4 in. by 4 in. blocks, tile pattern. The plans show a platform of Saginaw paving blocks and standard concrete curb. Heating will be by hot water, the boilers being located in the basement, below the baggage-room.

Successful Methods of Getting Contracts

Author Believes that Salesmanship Plays an Important Part in Getting Work Both on Competitive and Cost Plus Bases

EFFECTIVE methods of procuring contracts as practised by large construction organizations were described in the last two issues of the Contract Record by Leonard C. Wason, president of the Aberthaw Construction Company, and J. P. H. Perry, manager of the contract department of the Turner Construction Company. A third viewpoint is presented in an article which follows, prepared by W. P. Anderson, president of the Ferro-Concrete Construction Company. This article emphasizes, as do the other two, the importance of intensive salesmanship in closing contracts and the value as a booster of a contractor's reputation, which includes his dependability, experience, fair dealing and good work. Mr. Anderson's ideas of the proper methods are outlined as follows:—

From the experience of our company I feel that salesmanship plays an important part in obtaining work even on a competitive basis. This scarcely applies to competitive work let by public bodies, but even they have some discretionary power, and it is advisable to have those who control the letting of such work familiar with the reputation of the bidder. In bidding on private competitive work the owner is not bound by any rules and often favors a contractor on account of his reputation for fair dealing and excellent work.

Money Saved on Percentage Plan

There are certain general points to be considered in the selling problem regardless of the form of contract, and other points must be considered with particular reference to the class of contract under which the salesman is endeavoring to get the work. The overhead expense of a construction company is a small percentage of its total business. It can be made lower on work done on a cost plus a fixed sum or percentage than for work done on a flat price, as in the latter case many more careful and expensive estimates of cost are required in getting work. The money saved can be utilized in giving more to actual clients, by being liberal in settling disputed points, thus causing them to become repeaters and boosters, which is one of the greatest selling assets. The tendency in competitive bidding to estimate a great number of jobs is partially due to the fact that architects expect it.

Sometimes the contractor guesses or obtains a figure from other contractors in order to put in a high bid to satisfy the architect. High bidding does not hurt the competitive bidder as it creates a feeling of superiority, and, other things being equal, the superior firm gets the job, often at a higher price than his competitor. This may have a different effect on clients letting work on a cost plus a fixed sum or percentage basis, as here he is vitally interested in the contractor's ability to do good work at a minimum cost and maximum speed, with as little annoyance and friction as possible. Our salesmen emphasize these points as well as our firm's engineering ability, which often causes a great saving in original cost or in the operating cost when the building is in use, and we bring these facts home by having former clients write or speak of them to prospective clients.

Contractors Often Belittled

There is a tendency for architects and owners rather to look down upon the contractor, hardly considering him their equal, but as a slick fellow who will bear close watching. They consider it a favor on their part to allow the contractor to bid, not realizing the expense he is put to in so doing, and that they are the ones that need the favor and that in reality the shoe is on the other foot. The salesman should be independent and not tolerate this attitude, but consider himself absolutely on an equal plane. The class of men in control of the firms who are forging ahead in the field of getting work on a cost plus a fixed sum or percentage basis are of the highest type, and the reputation for honesty and merit required for this class of work does not go with servility.

Over 90 per cent. of our present work was obtained on a cost plus a fixed sum or percentage basis, which is growing in popularity due to the many advantages inherent in this form of contract. The Munitions Board, Council of National Defense, is thus letting contracts, due to the speed obtained thereby. The salesman must overcome a prejudice against this form of contract, as at first an owner cannot see the merits, often because he does not get work this way, and does not realize that the difficulty of checking costs in a factory, with large overhead expense and more than one client, is overcome where practically the entire work is done at one spot and for the client exclusively. The feeling that the contractor is a robber and hold-up must be overcome, but this feeling in general may be made an asset to the salesman where he can show that his firm does not possess these qualities and can convince the owner of the manifold advantages of the cost plus a fixed sum or percentage contract.

Salesmanship Wins the Work

It requires an exceptionally high type of man to go after this class of business. He should have a pleasing personality, be a good mixer, and have confidence, obtained by previous experience, in convincing clients of the advantages of the form of contract recommended and the exceptional service his particular firm can render. Often a complete knowledge of design and ability to estimate cost is necessary where the prospect is uncertain as to his exact needs and wishes suggestions or to know at once the costs of various types of building. In most cases, however, the salesman need not be an engineer, and should have no other duties which might interfere with his work.

To insure good workmanship, speed and satisfied clients each job needs a group of men thoroughly tried out in the company's own organization, and consequently the unit of sale is large and may average considerably over $100,000 for those jobs which are not near enough together to be handled by one organization. Consequently, although the percentage cost may be small, a large sum can be spent in landing a single job.

We find it better to confine our intensive salesmanship work to a limited number of very good prospects instead of trying to go after all the prospects we hear of. When a prospect looks good, however, stick to it until the job is landed or lost.

In short, the secret of the successful selling of a construction company's service is to first build up an efficient organization, obtain a high reputation for honesty, engineering ability, fair dealing, speed and good work, and then convince prospective clients of these facts and the advantages of having this kind of a contractor do his work.

Gravity Rollers Economical for Handling Building Materials

A RECENT development in the building construction field is the employment of gravity roller conveyors for transporting materials, thus doing away in a measure with hod carriers and wheelers. This method of handling cement, tile, brick, mortar and even form lumber has been used in connection with the erection of many of the largest reinforced concrete buildings built in the last few months.

Five Per Cent. Sufficient

The conveyors consist of ball bearing rollers assembled in a steel frame. They are made in sections and provided with couplings which permit a line of any desired length to be assembled quickly. The conveyor line is supported on horses or on adjustable jacks, one at each coupling, and is given a slight incline. Ordinarily a fall of 5 per cent. is sufficient to move any kind of building material. The portable units of the Mathews' standard conveyor are 4 ft. and 8 ft. in length for the straight sections. The curve sections are made in 90 deg. and 45 deg. angles. The conveyor designed mainly for handling brick is made in widths from 8 in. to 10 in. and ranges in weight from 18 lb. to 24 lb. per lineal foot. Conveyors for other clases of materials are made in various widths from 12 in. up to 18 in., and with rollers spaced from 3-in. centers up to 18-in. centers. A 12-in. carrier with rollers spaced 3 in. from center to center weighs 21 lb. per lineal foot. The same carrier 18 in. wide runs to 26 lb. per lineal foot.

Among the larger contractors using the Mathews conveyor is the Aberthaw Construction Company, of Boston, Mass. This company carries the conveyor as a part of its standard equipment and a specified length is shipped with the other equipment to every construction job of any size. The possession of such equipment leads to considerable ingenuity in its use.

For example, at the Stanley Works job in New Britain, Conn., cement was unloaded in the early stages of the work, and cement being conveyed only about 20 ft. The brick on this job was also unloaded by means of a carrier, and lumber was conveyed from stock piles to the saw bench. Considerable saving was effected by moving the lumber in this way, although no figures can be given. In this connection, it is interesting to note that the finished building of the Stanley Company is equipped with a gravity circular conveyor which runs from the eighth floor down to the second floor, making four complete turns in seven storeys, with 6-ft. 3-in. radius and 3-ft. 8-in. clear opening in the center. The conveyor handles the goods as packed on all floors, and delivers them to the second floor, whence they are placed either in storage piles or in freight cars.

Economy in Unloading Cars

In connection with the construction of the large building for Colt's Patent Fire Arms Mfg. Co., at Hartford, Conn., one of these carriers effected very great economy in unloading cement. The building ran at right angles to the track where the cement cars were set, and the cement shed was placed in the angle formed by the building and the tracks about 30 ft. away from the building, and perhaps half that distance from the track. Several cars were placed on the siding at one time in some instances, and it was not always possible to have the cement cars at the point nearest the cement shed. The carrier was, therefore, set up in some instances a distance of as much as 300 feet on either side of the cement shed. Cement was placed four bags on a wooden pallet, and the pallet placed on a carrier which conveyed it parallel to the track until oposite the cement shed when it turned a right angle and ran into the shed where the cement was removed and piled. This shed carried the storage for the job, which consisted of about 30 per cent. of the net requirements of barrels. The balance of the cement was unloaded from the cars to the mixers which were about half way down the building, where there was not sufficient grade to use the gravity-carrier. The railroad tracks were elevated probably 12 ft. above the level of the cement shed floor.

Another instance in which this conveyor was used by the Aberthaw Company was on some recent work for the Fore River Shipbuilding Corporation at Quincy, Mass. It was found necessary to move a pile of creosoted railroad ties numbering about 1,200 to a point about 75 feet distant. A line of gravity carrier was set and the ties placed on it one at a time lengthwise and transported without difficulty. The ties were loaded by two men and unloaded and piled by four men at an estimated cost of about half of the expenditure that would be necessary if they had been handled a similar distance by hand.

Meeting of Royal Architectural Institute of Canada

The Royal Architectural Institute of Canada will hold its tenth general annual assembly at Ottawa, Ont., on October 1 and 2. The headquarters of the assembly will be at the Chateau Laurier, where the business meetings and council meetings will be held. The only item on the program for the first day is the meeting of the 1916-17 council. On the following day the convention will be inaugurated, under the presidency of Mr J. P. Ouellet, and the general business of the assembly transacted.

Tractive Efforts on Various Road Surfaces

Hard Surface Roads Require Less Pulling Effort Than Softer Types—Concrete Shows Best Results

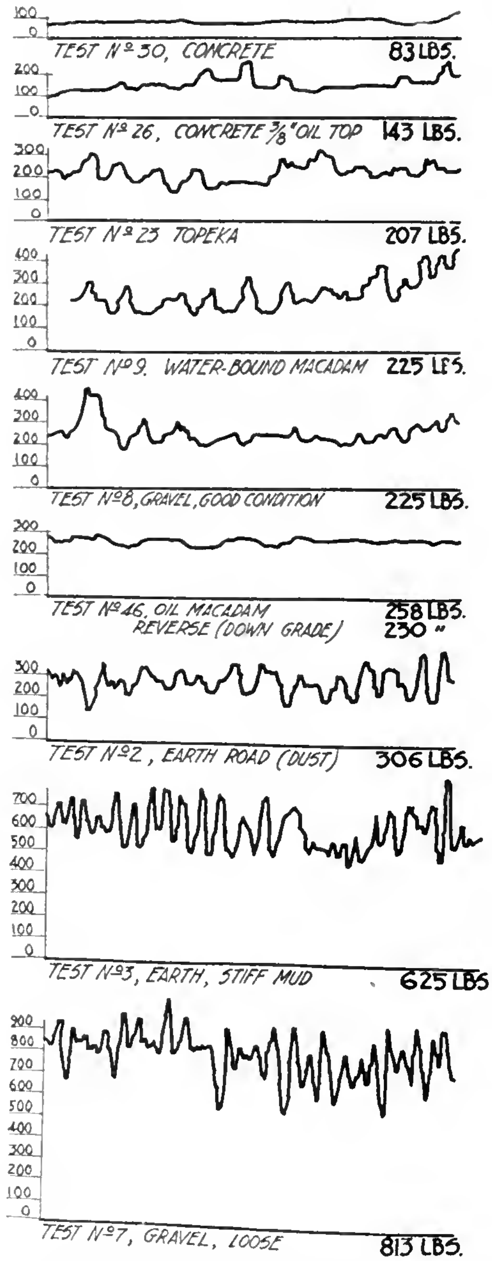
TO determine how road surfaces affect the tractive effort experiments have recently been conducted on a number of California roads of various types. Although these tests were primarily con-conducted to obtain authoritative results applying to soil and weather conditions found in that particular state, the conclusions derived therefrom are universally valuable in indicating the economy effected by improved road surfaces. The draft required to move a loaded wagon on different types of road has been made the subject of repeated investigations, and in so far as it relates to the waste of power and money which results from hauling heavily-loaded wagons or trucks over bad roads, the conclusions show the inherent good qualities of the high type of modern road as opposed to mud or dirt roads.

All Factors, Except Road, Kept Constant

The tests described in this article were conducted on the following types of road: Earth road, dust ¾ in. to 3 in. deep; earth road, stiff mud, firm underneath; gravel, compact, in good condition; gravel, loose, not packed; water-bound macadam, good condition; oil macadam, good condition; concrete, unsurfaced, smooth; concrete, ⅜ in. top asphaltic oil and screenings; concrete, 1½ in. Topeka top; Topeka top, 1½ in. on plank. The object was to determine the tractive resistance of a standard farm wagon when loaded on these surfaces. As far as possible, all factors influencing the tractive resistance of a loaded wagon, except the road surface itself, were either eliminated or maintained constantly throughout the test. Thus one wagon with the same load was used and was drawn by a team in all the tests except those on an oil macadam road where a motor truck was used. A standard farm wagon was employed having steel axles of equal length with wheels 38 in. and 46 in. in diameter and 4 in. tires. The load was 6,000 pounds gross, consisting of rice in sacks. The motive power was supplied by a team of draft horses weighing about 1,600 pounds each. The motor truck was used in the tests on oil macadam. To secure uniformity of conditions, the same wagon, the same load, the same driver, and the same horses were employed, and practically the same speed was maintained in the horse-drawn tests. When the truck was utilized, as motive power the same driver was constantly used. Uniform weather conditions prevailed in all the tests made, the temperature reaching a maximum of 105. The warm weather was the occasion for an increased tractive resistance on the oil roads over that for average temperatures.

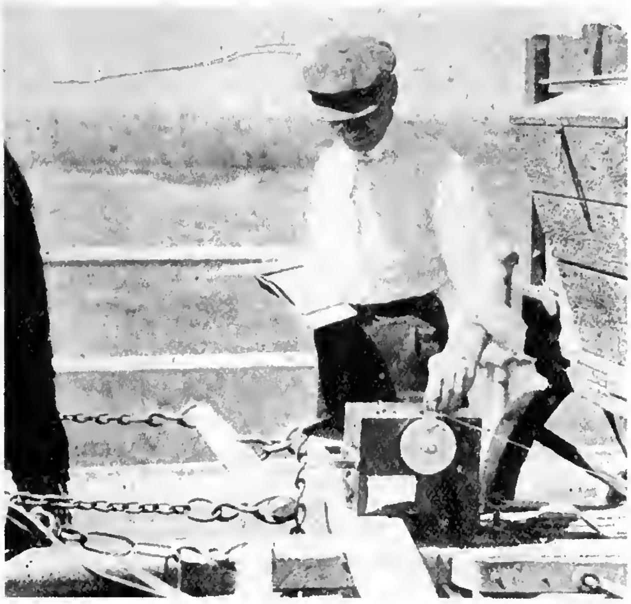
Special Dynamometer Measured Pull

The tractive effort was measured on a special dynamometer, mounted on the tongue of the wagon, its pull being transmitted by a sliding bar along the tongue. The dynamometer was of the integrating and recording type known as the "Iowa," designed by Professor J. B. Davidson, of the University of California, under whose directions the tests were conducted. The force representing the tractive resistance of the loaded wagon, acting through the instrument, compresses a spring carefully calibrated to indicate the force acting. The average resistance over a uniform distance, measured automatically, is indicated by the instrument at the end of the run. At the same time it retains a graphic record of the resistance on a strip of paper drawn under a recording needle. This record is used to check the average results furnished by the instrument. It is stated that this dynamometer is one of the most accurate instruments of its kind.



Sample records made in the tests. The height of the irregular line above the base line indicates the force acting to overcome tractive resistance. The irregularities are due primarily to the uneven pull exerted by a team.

The tests were started after the load was in motion and moving at a uniform rate. The rate of travel was decided in each case, and averaged 2.4 miles per hour for the team. On grades tests were made both up and



Special dynamometer registers pull, which is transmitted from doubletree through instrument to clevis.

down grade and the results averaged. The distance through which the tractive efforts were measured was in all cases 50 ft.

Superiority of Hard Roads

The curves and table show the results obtained, and serve to indicate the superiority of the hard surfaced roads. Comparison between the lowest pull recorded, that necessary to keep the three-ton load moving, after it was started, over the level, unsurfaced concrete road, which amounted to 83 pounds, or 27.6 pounds per ton, and the pull through stiff mud, which was 654 pounds for the load, or 218 pounds per ton, furnishes ample food for thought. Over the concrete road the horses pulled together 83 pounds, each horse pulling only 41½ pounds, while over the mud the team pull was 654 pounds and the pull on each horse was 327 pounds. The difference in pull between the concrete road and the mud road was 571 pounds, a difference of 285½ pounds pull for each horse, which is wasted energy, wasted as absolutely as if it never had existed.

Typical Results for Various Surfaces

Kind and condition of road.	Tract. Resist. Total.	Per ton.
Concrete (unsurfaced)—Smooth, excellent	83.0	27.6
Concrete (unsurfaced)—Smooth, excellent	90.0	30.0
Concrete (⅜ in. surface asphaltic oil and screenings)—Smooth, excellent	147.6	49.2
Concrete (⅜ in. surface asphaltic oil and screenings)—Smooth, excellent	155.0	51.6
Macadam (water-bound)—Smooth, excellent..	193.0	64.3
Topeka on concrete—Smooth, excellent	205.5	68.5
Gravel—Compact, good condition	225.0	75.0
Oil macadam—Good, new	234.5	78.2
Oil macadam—Good, new	244.0	81.3
Gravel—Packed, in good condition	247.0	82.3
Topeka on plank—Good condition, soft, wagon left marks	265.0	88.3
Earth road—Firm, 1½ in. fine loose dust	276.0	92.0
Topeka on plank—Good condition, but soft ...	278.0	92.6
Earth road—Dust ¾ to 2 in.	298.0	99.3
Earth—Mud, stiff, firm underneath	654.0	218.0
Gravel—Loose, not packed	789.0	263.0

In testing the pull necessary to move the load over the earth road results upset the theory sometimes expressed that the good earth road is as easy to pull over as any other type. This contention does not prove up, as the tests show that the pull required was 3 1/3 times as great as over unsurfaced concrete and nearly twice as great as concrete with a 3/8 in. skin top.

Building a Concrete House in Three Days

Speedy Erection of One Hundred Buildings Due to Excellent Organization—Special Steel Forms—Small, Mobile Mixers

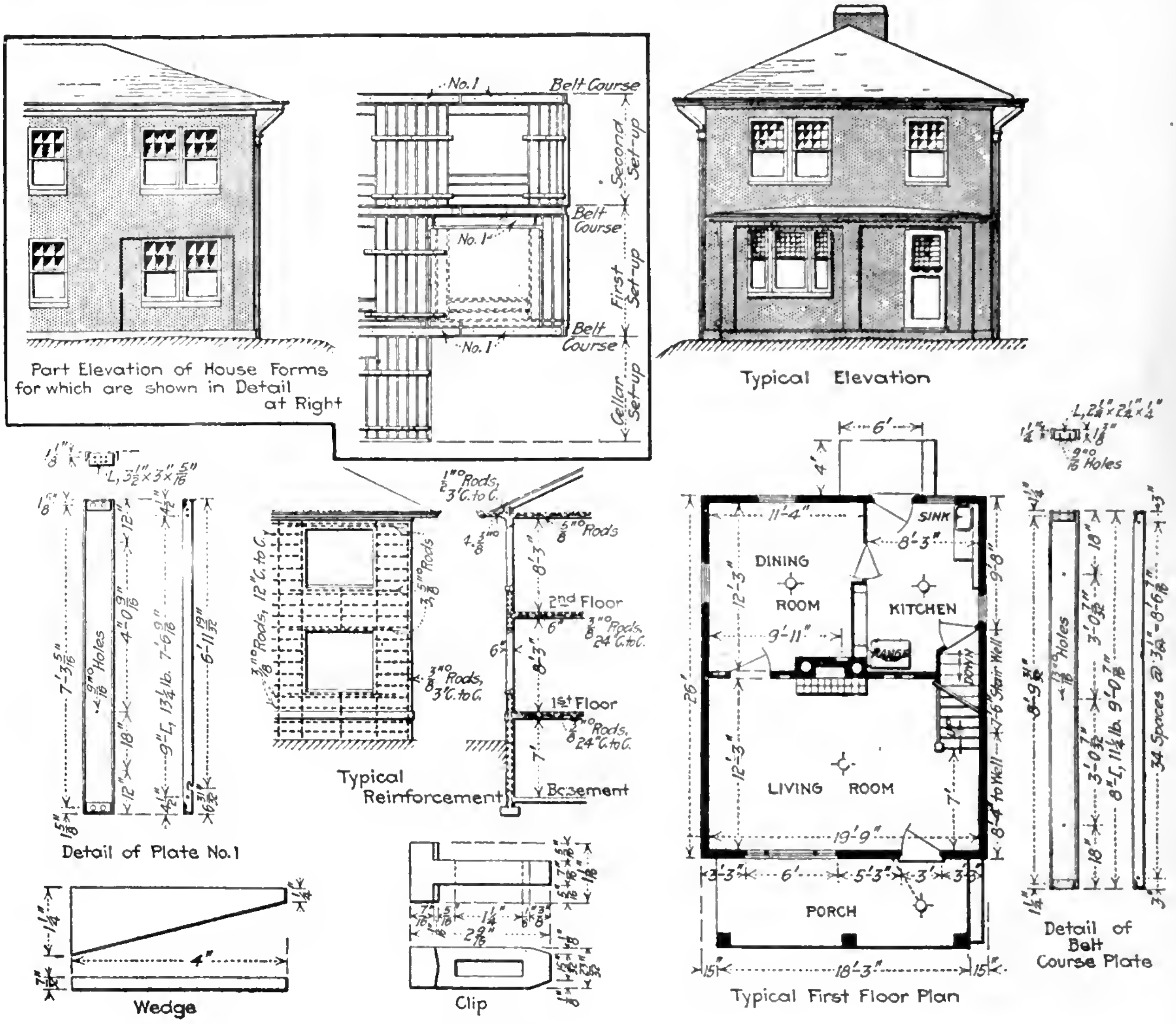
IN industrial townsites developed by large organizations, the buildings are usually of a standardized design and in many cases, of wooden construction. The American Steel & Wire Company is at the present time developing a small townsite, however, in which the dwellings are of concrete. The designs are pretty well standardized, providing cheap, serviceable buildings of good appearance. About 100 buildings are being erected and the contractors have developed methods which result in great speed. By the use of steel forms and contract methods similar to those used on large construction, the completion of one house every three days has been attained. The methods of construction and the organization are described in an article in the Engineering News-Record, from which the following notes are obtained:—

The success of the work is due primarily to the application of orderly contract methods to a design which was well worked out in the first place. The contractor did not come on the job until after some few houses had been completed, at great trouble and expense, by a contractor of less experience. So it is fair to assume that the methods now used are of at least as much importance as the original design. In fact, the contractor considers that in future developments changes in design could be profitably made.

Eight Styles of Houses

The houses were designed by the Lambie Concrete House Corporation, of Boston, Mass. Eight different styles of houses are being built, containing some four, some five, and some six rooms, all with a bath and cellar. Of these, a few are being built in pairs with party walls, and the rest are all detached. The contract prices for a house complete range from $2,000 to $3,300, but such costs are based on prices for some time ago and can hardly be used for present comparison. The costs include gas furnaces and cooking ranges, electric lighting and the usual improved kitchen and bathroom equipment. The average floor area is 26 x 26 feet.

The houses are all of the box type with 6-inch solid concrete walls reinforced vertically on both faces and horizontally on the outer face with straight rods, with



Details of houses, reinforcing and steel forms.

an intermediate partition wall cutting down the floor space to 12 to 15 feet. The floors are of the ribbed reinforced-concrete type, with the ribs or beams spanning between the outer and interior walls. These ribs are left exposed in the cellar, but in the other floors plaster board is nailed to strips left in the concrete and a finish plaster coat made. The buildings are finished at the top with a reinforced-concrete cornice in which a gutter is formed, and on top of the concrete ceilings a roof is built up of spruce framing covered with asbestos slate so that the whole of the exterior of the building, with the exception of this frame, the wooden window and door frames, and wood stairs, is fire-resisting.

Special Steel Forms Effectively Used

An important factor in the effectiveness of the work is the forms. These are of the special steel channel type patented by the Lambie Concrete House Corporation. They consist of 9-inch channels set up vertically and connected together with clips and wedges passed through slotted holes in the flanges of the channels. At the corner of the building a 4 x 4-inch steel angle is set up, and the forms are lined up longitudinally by means of a steel channel used to form a belt course. This not only fastens the forms of the lower floor, but is bolted into the floor reinforcement and remains in place for a support for the second-storey forms and is only stripped at the last when all the concrete is poured. The steel wall forms also support the floor forms, which are steel domes, arrangement being made by which the steel channels on which the domes are laid are bolted to the inner side of the steel wall forms. The cornice has to be built inside special wood forms supported by wooden struts reaching down to the belt-course channel form.

The cellars were excavated with a steam shovel which went down a street, taking out a strip the depth of the houses. The space between the walls of the houses is backfilled after the cellar walls are placed. The digging was in hardpan with some shale, but all of it was taken out by the steam shovel.

Forms Moved From One House to Next

The construction of the houses proper is done in groups, to fit the number of sets of forms, which are taken down as soon as possible and moved on to the next group.

The usual method is to set the forms of one storey —wall and floor together—and then to pour the concrete for this section all at once. The progress of the job is limited by the setting of the concrete. To form, pour and strip each storey takes about seven days. Working at this rate, the house of two floors and cellar is completely concreted in three weeks, and with the twelve sets of forms on the job, twelve houses are concreted in this period. After this the plumbing, heating, plastering, roofing and finish are done, which take about five weeks more, so that the houses are being completed at the rate of twelve in the first eight weeks and twelve every three weeks thereafter.

During the months of May, June and July the progress made was as follows: 28 complete houses(counting double houses as one) were concreted in 12½ weeks, or at the rate of a house every three days. In the last month quite a number of houses were concreted very quickly—that is, from the day starting erecting basement wall forms on the footings, to and including the day the roofs were concreted. The last houses have gone up as follows: Two in 13 calendar days, one of which could have been done in 12, except for shortage of sand, 2 in 14 days, 5 in 15 days, 2 in 16 days, 2 in 17 days, 3 in 19 days, 1 in 20 days, and 1 in 21 days. Under ordinary conditions these houses could have been built with one set of forms.

Concrete Tower Replaced by Small Hoists

In the original contract for the houses, concrete was placed from a high stationary tower, with a chute. This proved inefficient, because of the number of moves that had to be made to control the whole housing area. There is so small an amount of concrete in each house, 125 cubic yards on the average, and the houses are so scattered that the cost per yard of concrete was materially increased by the cost of the tower erection and construction. After a long study of different methods the Aberthaw company decided on small mobile concrete mixers, which could be placed alongside each house during concrete placing, and small hoists on each building.

The plant consists of three Koehring "Dandie" one-bag gasoline-driven mixers, two of which are equipped with side loaders, three Sasgen circle swing derricks; two Novo gasoline-driven hoists, which control derrick and mixer. The slag aggregate, and sand, as well as the cement, are delivered to the mixer by means of a truck which brings the material from the contractor's unloading yard, located in the yard of the American Steel and Wire Company.

The Sasgen derrick is not used for pouring the basement and first floor, but is used for all concreting above that. It is bolted securely to the best course on one corner of the building, and the concrete is hoisted in concrete buggies or wheelbarrows. Better results have been obtained with the buggies than with the wheelbarrows. Each wheelbarrow has a hook bolted to the front end and is lifted by the derrick by means of three steel arms with rings on the ends, two of which hitch to the handles and the third into the hook on the barrow, so that it is lifted completely and level onto the floor.

How the Organization Works

The organization on the job is a superintendent, assistant superintendent, civil engineer, material clerk, two cost clerks, timekeeper, planning department and stenographer. The formwork is under supervision of one carpenter foreman, five squad bosses, two stripping foremen, two move foremen, one reinforcing steel boss, one finish carpentry boss, three concrete bosses and one excavation boss.

It was found advisable to have a squad boss in charge of the carpenters and helpers working on each house. This boss has four carpenters and four helpers on the smaller houses; and on the large double houses, up to seven carpenters and seven helpers. The work has been most economically done when the carpenters and helpers worked in pairs—that is, each carpenter has a helper to assist him in moving the forms, etc. It will be noticed that the reinforcing steel boss comes under the carpenter foremen. This has been found desirable, as the steel must be placed rapidly whenever the carpenters are ready for it. The planning department on the job lays out progress each day for the next three days and shows which foreman is to erect forms on each house and which concrete gang will pour them.

Five Carpenter Gangs Erect Forms

The number of men in a concrete gang varies from 13 to 15, according to the type of house and the amount of concrete to be poured. The number of gangs at work at the same time is five carpenter gangs erecting forms, two concrete gangs concreting forms, two stripping gangs stripping forms, one concrete gang concreting footings, pavings, porch floors, floor steps, chimneys, etc., one digging gang, and one finish carpentry gang, doing the furring, roof framing and roof boarding, erecting door and window frames, sash, doors, inside and outside trim, stair laying, floors, etc.

On a large-type six-room house group this force has taken approximately 1½ days to erect basement walls and first-floor forms, including all boxes, window frames, flues, etc. Concreting basement walls takes about 2½ hours, and 1½ hours to pour the floor. Stripping and erecting the basement wall forms on the first storey takes 1½ to 2 days. The stripping of the first-storey walls and erecting the second storey and putting on the floor takes about 1½ days, but the putting on of the cornice is a slower operation and adds from half a day to a day to this. Concreting the walls takes about 2½ hours, and the roof about the same length of time.

Detail Costs are Given

The steel reinforcement varies from 1½ tons in the smallest type of single houses to three tons in the largest type of double houses. The labor on wall steel has cost to date $11.90 a ton and the floor steel or beam steel $7.50 a ton. The cost of labor on wall forms to date has been $4.30 a hundred square feet and the stripping has been $2.10. This does not include the moving of forms onto the lots, which has cost about $55 per house, or about $1.25 per 100 sq. ft. of wall.

The quantities of concrete per house vary from 145 cubic yards for the largest double house down to 85 for the smaller single houses. This includes all walls and floors, footings, pavings, porches and chimneys. At the present time it is costing about $2.25 per cubic yard to place the concrete in the first and second-storey walls, which are 6-inch walls, and it costs the same for the floor slabs. The smaller houses have about 15 cubic yards of concrete in the first or second-storey walls, and 6 cubic yards of concrete in the first and second floors. The roof, including the cornice, has about 10 cubic yards. The cost of erecting the formwork, including handling, stripping and cleaning, is averaging about 50c. per square foot. As no lumber is required for the wall forms, this is doubtless considerably cheaper than work of this class could be done in wood.

Are Sprinkling Filters Objectionable?

Investigation Shows That if Plants Are Properly Designed and Operated and Sewage is Fresh, No Odors Are Noticeable

A STUDY has recently been made by Mr. Kenneth Allen, engineer of sewage disposal for the Board of Estimates and Apportionment of New York City, regarding the objectionable features of sprinkling filters in connection with sewage treatment works. Enquiries were made concerning some forty municipally-operated plants, and answers were obtained from fourteen of these, including the more important installations. A summary of the replies is given in Tables I. and II. The results of Mr. Allen's investigation are given in a recently issued report, from which the matter in this article is taken.

So far as can be learned from the answers, as well as from personal visits to a large number of plants, it is Mr. Allen's opinion that if the sewage is reasonably fresh and the plant properly designed and operated, odors will rarely be noticed at a distance greater than 600 or 800 feet. But two of the cities heard from—Baltimore and Columbus—have had complaints traceable to sprinklers, and in both cases the sewage is delivered in a septic condition.

The question arises: How old must sewage be to reach this condition? Obviously this depends on the constituents of the sewage, the temperature, its access to the open air, and its possible contact with decomposing deposits.

There is so little accurate information to be had as to the velocity of flow in sewerage systems that it is difficult to assign any definite period of collection that is necessary to bring the sewage to a septic condition. It would obviously be unfair to take this period as that required to deliver the sewage from the most extreme point of the system, as the tendency to septicize this presumably small portion of the whole would be partly neutralized by the larger subsequent volumes of inflow containing a residium of oxygen. Probably a point somewhere between the centre of population and this extreme point would be more reasonably assumed as the point from which the oxygen is gradually depleted until reaching the treatment plant.

Mr. F. D. Smith, chief engineer of sewage works, Metropolitan Water and Sewage Board of Massachusetts, writes:

"The sewage of the Metropolitan sewers is, in general, in septic condition when discharged through the outfalls, owing to the length of the mains. Some of these mains, together with the lateral sewers, have a length exceeding 25 miles.

"I am not able to state definitely the length of time before the sewage could be termed stale or septic. The chemist of the State Department of Health of this state, who makes examination of the condition of sewage in our sewers, informs me that after 20 to 24 hours,

TABLE I.—ODORS DUE TO SPRINKLING FILTERS.

Town.	Volume of sewage gal. per day.	Condition at delivery. Tanks.	Condition at delivery. Nozzles.	Distances that odors are Noticeable. Unfavorable conditions.	Distances that odors are Noticeable. Once a month in summer.	Distances that odors are Objectionable. Unfavorable conditions.	Distances that odors are Objectionable. Once a month in summer.
Atlanta, Ga.	13,000,000	2 plants fresh 1 plant stale	Fresh Stale	400 ft. 700-800 ft.	......	......	......
Baltimore, Md.	45,000,000	Stale	Septic	⅓ to ½ mile	......	⅓ to ½ mile	......
Batavia, N. Y.	2,000,000	Slightly septic	Slightly septic	800 ft.	......	None	None
Bloomington, Ind.	600,000	Fresh	Septic	1,000 ft.	......	800 ft.	......
Chambersburg, Pa.	700,000	Fresh	Fresh	½ mile	½ mile	1,000 ft.	1,000 ft.
Columbus, Ohio	21,000,000	Septic	Septic	1 mile	¼ mile	1 mile	¼ mile
Fitchburg, Mass.	2,123,000	Fresh	None over 8 hours old	300-400 ft	......	None	None
Gloversville, N. Y.	2,800,000	Fresh	Fresh	500 ft.	500 ft.	None	None
Indiana, Pa.	657,000	Fresh	Septic	200 ft.	400 ft.	......	400 ft.
Lebanon, Pa.	800,000	Fresh	Septic	Practically no odor		300 ft.	None
Philadelphia, Pa.	1,250,000	Fresh	Fresh	500 ft.	Ordinarily less than 50 ft.	500 ft.	Ordinarily less than 50 ft.
Reading, Pa.	6,000,000	Fresh	Settled 7 hrs.	300 ft.	......	300 ft.	......
Schenectady, N. Y.	10,000,000	Fairly fresh	Nearly stale	700 ft.	......	700 ft.	300 ft.
Washington, Pa.	1,400,000	Septic	Septic	1,500 ft.	400 ft.	1,200 ft.	300 ft.

TABLE II.—EFFECT OF SEWAGE TREATMENT PLANTS ON PROPERTY VALUES.

Town.	Distance to nearest residence.	Complaints due to odors, flies, etc.	Effect on property values due to construction and operation of plant.
Atlanta, Ga.	300 ft.	None	Property values about plants have increased
Baltimore, Md.	1,300 ft.	Several complaints due to odors and flies	None
Batavia, N. Y.	381 ft.	None	None
Bloomington, Ind.	1,500 ft.	Complaints from flushing about 3 times a year. None from plant.	......
Chambersburg, Pa.	600 ft.	None	None
Columbus, Ohio	1,300 ft.	Complaints due to stale condition of sewage	An alleged decrease. Unable to verify
Fitchburg, Mass.	1,000 ft.	None	None
Gloversville, N. Y.	900 ft.	Complaints due to sludge beds—none to filters	4 properties 200'-600' from sludge beds depreciated 25-33⅓%
Indiana, Pa.	1,300 ft.	One complaint due to sludge removal	None
Lebanon, Pa.	600 ft.	None	None
Philadelphia, Pa.	2,000 ft.	None	None
Reading, Pa.	1,300 ft.	Complaints due to cleaning tanks—not to filters	None
Schenectady, N. Y.	1,100 ft.	Complaint due to undigested sludge in early operation of plant	None
Washington, Pa.	1,000 ft.	Complaints from discharge of undigested sludge. None for 2 years	Apparently none

depending upon the season of the year, they regard the sewage as septic."

By reference to Table I. it is noted that the sewages of Batavia and Schenectady reach the plant at about the time when becoming septic.

Flush Sewers Once a Year

At Batavia decomposition seems to be promoted by deposits in the sewers as "if the sewers are flushed once a year during the summer months the sewage arrives at the plant in a fresh state." This would be expected, as the extreme distance traveled is but about 2½ miles.

At Schenectady the extreme flow is about six miles and that from the centre of population about 4½ miles, as measured along the sewer. A careful computation indicates the extreme distance and time of travel by two routes to be: Route 1—From State Street, 5.9 miles, 4 hr. 36 min. Route 2—From Fifteenth St., 6.45 miles, 5 hr. 56 min. The sewage is fairly fresh on arrival, but is approaching staleness on reaching the nozzles after settling.

From Table I. it also is shown that the sewage arrives at one of the Atlanta plants and at the Baltimore, Md., Columbus, O., and Washington, Pa., plants in a stale or septic state.

The extreme distance of travel at Atlanta is about five miles, and that from the centre of population four and one-half miles. The maximum time of travel is about four and one-half hours, due in part to the flow for about three quarters of a mile through an old creek bed, which will be replaced by a sewer later when the sewage is expected to arrive in a fresh condition.

At Baltimore the sewage from the centre of the city travels about eight miles, and is some five hours old when received, although some is probably derived from a distance exceeding ten miles.

At Columbus the centre of population is stated to be four miles, but the most extreme point ten miles from the plant.

At Cleveland a travel of five miles renders the sewage "distinctly stale."

Sewage from a Distance Is Stale

From the above it would appear that sewage brought from a distance of over six or eight miles from the centre of population, under ordinary conditions of flow and in warm weather, is likely to arrive in a stale condition. This is confirmed by the condition of the sewage reaching the sewage testing station at Cleveland, where it arrives in this condition when six or eight hours old, while, indicating this to be about the limit, the sewage from Fitchburg reaches the plant when most of it is not over three, but some of it nearly eight hours old in a fresh condition.

This conclusion, being based upon so few examples, must, of course, be considered as tentative and liable to modification; and, in any case, the limiting time depends, as already pointed out, on such matters as temperature and contact with the air.

The foregoing discussion indicates, in a general way, that a nuisance may arise from a sprinkling filter plant; that experience in other cities goes to show that such nuisances are more apt to be traced to other features of the plant, such as sludge handling, than to the operation of the filters themselves; and that odors are liable to be produced during warm weather by sprinkling filters handling a stale or septic sewage that may affect property values located a quarter of a mile or more from the plant.

It is probable, too, that sewage delivered from ordinary septic tanks to sprinkling filters is more liable to cause odors than when delivered from Imhoff tanks, not only on account of the longer retention customary with the former type, but on account of the withdrawal of oxygen due to contact with the decomposing sludge and to absorption of the malodorous gases evolved during this decomposition.

Placed Far from Habitation

Where large volumes of sewage are to be treated, therefore, sprinkling filters should handle fresh sewage only, or else be placed far from habitable property.

In the selection of a method of oxidizing treatment for a period of forty years or so hence, the more sluggish flow, and consequently nearer approach to a septic condition of the sewage on reaching the plant that will obtain during the early years of operation, should not be overlooked. With a velocity of, say, 1.5 instead of 3 ft. per second, the age of the sewage would be doubled; and, in addition, there would be the greater liability of deposits, resulting in an additional draft on the oxygen remaining in the liquid, with a further reduction of the time required to bring about anaerobic decomposition. Another consideration which has not been touched on is the area required. If, for instance, it should turn out that the activated sludge process were otherwise advantageous, it would have the additional merit of requiring much less area—probably from a quarter to a fifth of that necessary for sprinkling filters. In some localities this would be a consideration of much importance.

Unusual Lock Wall Design

Concrete Blocks Built up to Form Underwater Piers—Divers Set Foundation Courses Guided by Framed Template

An unusual type of construction is exhibited in the grade wall of a lock at Troy, and is described in "Contracting." It consists in part of large concrete blocks built up to form underwater piers. The hollow blocks were lowered to position, connected by anchoring reinforcement rods, and filled with concrete.

The piers, 20 ft. apart on centers and from 20 to 25 ft. in height, carry a solid concrete wall 12 ft. high and 14 ft. thick at the base. The piers were made in five courses 5 ft. high at the base and 3 ft. high at the top, and the shells of the hollow blocks were made with walls 4½ inches thick reinforced by vertical sheets of 4-inch triangular mesh and ½ in. square vertical rods besides which vertical stirrups were cast in the walls to provide connections for hoisting tackle.

In order to resist the pressure of the wet concrete in the hollow blocks they were braced by diagonal rods in both directions and by longitudinal and transverse horizontal rods which later proved troublesome on account of the obstruction they offered to the tremie by which the hollow blocks were filled with concrete.

The 78 hollow blocks for the piers were cast on shore with 1:2:4 concrete, using an aggregate of sand and gravel provided by hydraulic dredging in the excavation.

While the hollow blocks were being cast the site of the wall was dredged and the high spots on the rock surface were drilled and blasted by the drill boat.

and the broken rock removed by a clamshell bucket at a total cost of $665.44 for a net area of 235 x 22 ft., including the spaces between piers.

Anchorage to Rock

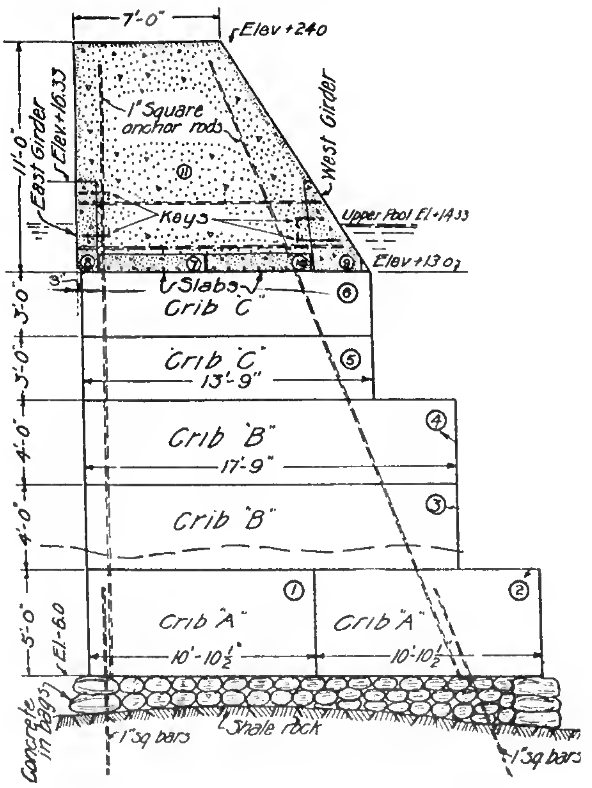
Holes were drilled in the rock and short 1 inch square vertical and inclined bars were placed in them by divers to anchor the first tier of hollow blocks. The blocks, having a maximum weight of seven tons each, were handled to position by a derrick, their alignment being facilitated by vertical projecting wooden guide strips bolted to the inside of the walls.

In order to provide proper bearing on the irregular rock surface for the lower edges of the 21-ft. 3 x 9-ft. 6-in. bottom blocks a footing of concrete bags was built by divers to support the edges of the blocks. In order to build this comparatively narrow footing in exactly the right position and to the required uniform height it was located and gauged by means of a large framed template sunk to position and moved from place to place to serve successive piers.

The template consisted of a skeleton 10 ft. 6 in. by 22 ft. 3-in. framework 6 ft. high with top and bottom horizontal steel gusset plates projecting from each corner and bored to engage long 4-in. vertical steel guide pipes.

These pipes were carefully located and driven to sufficient penetration in the bottom, after which the gusset plates were engaged with them, and the template, made of 6 x 8-in. timbers and 2 x 8-in. braces, was lowered to the required elevation indicated by a graduated rod and held there by tackles.

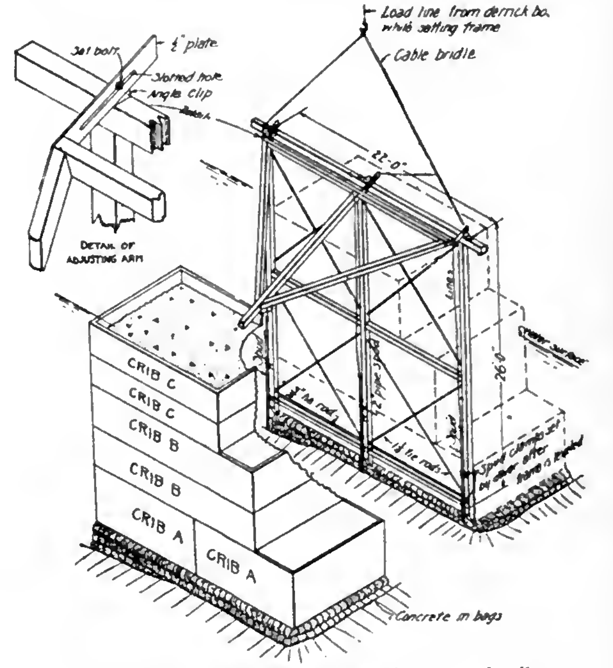
Concrete bags were lowered in skips to the divers



Monolithic wall and supporting pier on bag foundations.

who built them up into rectangular walls under the lower edges of the template and extending to the bottom surface of the latter. It then remained only to lower the concrete block in exactly the same position as the template had been lowered to insure its complete and accurate bearing on the bag foundation.

The hollow blocks were set by the divers aided by a suspended vertical guide frame held in position by guy lines above and by short 2-in. steel spuds at the bottom. After the lower block of each tier was set the diver spotted the drill holes for the anchor rods, telephoning instructions to the drill boats above which



Framed template for locating courses of piers set by divers.

drilled them, afterwards inserting the anchor rods and grouting them by means of casing pipes.

After the upper courses of the hollow blocks were set the long anchor rods were put in position, connected to the upper ends of these short rods, and held in position at the top by wooden templates.

The cost of labor for placing the anchor and reinforcement rods was $203.59 for drilling, $1,051.82 for placing steel and grouting, and $55.86 miscellaneous, making a total of $1,311.27. The cost of drilling was $0.313 per foot.

Moving Pictures Show Water Powers of Canada

The opening meeting of the Toronto section of the American Institute of Electrical Engineers will be held in the lecture room of the Engineers' Club, 96 King St. West, on Friday, Sept. 21, at 8 p.m. The feature of the evening will be a series of moving picture films illustrating water-powers of Canada. This series, which is said to be the first and only one of its kind, affords a remarkable insight into the development of our water-powers, particularly in Ontario. The films depict in a most wonderful fashion the generation of electric power, its transmission, distribution, and conversion for numerous industrial purposes. All are welcome.

Reinforcing for North Toronto Bridges

A very considerable portion of the reinforcing steel for use in the two concrete viaducts of the C. P. R. at North Toronto, described in the Contract Record of August 22, was bent and fabricated at the plant of the Burlington Steel Company at Hamilton, ready to be placed in the work. The entire reinforcing steel for both bridges is being supplied by this company.

Municipal Piggeries Pay

Experience in Worcester Indicates That Garbage Disposal by This Method is Economical and Sanitary

IN Worcester, Mass., U.S.A., the garbage is disposed of through the agency of a municipal piggery. It is said that feeding refuse to hogs has proved the most economical and satisfactory method of disposal in this city, and that it can be done in a sanitary manner, without appreciable odor, if given intelligent care. This city has found that the cost of collection has been just about covered by the revenue. Owing to the rather unusual features of this mode of garbage disposal we are reprinting the following facts, from an article by Frederic Bonnet, in Engineering News-Record:

Worcester is one of the old and well-established cities of New England, with a population of about 175,000. It is an industrial city, with many diversified industries, but with no unusual characteristics. Today about 70 per cent. of the garbage of Worcester (20 to 30 tons per day) is taken to the Home Farm and fed to 2,000 to 3,000 pigs.

The Home Farm proper consists of 376 acres, owned by the city. In addition, the city leases a farm of 220 acres.

Offal Is Buried

The city is divided into 21 districts, from which the garbage is collected twice a week, without charge to the householders or business men. There is also a special collection for the fish offal and rotten eggs from markets and commission houses, which collection is made daily in special cans with tight-fitting covers. These cans are provided by the dealers. Since this material is not fed to swine, but is buried, no revenue is derived from it, and it is a direct tax on the scavenger department of $1,760 per year.

Hitherto most of the hotel, restaurant, and hospital garbage was privately collected, but, owing to the recent falling off of the quantity and quality of the garbage, more of this is gradually being collected by the city. Some private collectors also obtain the privilege of collecting in certain outlying districts.

For the city collectors one load is considered a day's work. The teams leave the Home Farm at 7 a.m., and have on an average a 13-mile haul daily (maximum 18 and minimum 10). It requires from two to four hours to make a load. Owing to the fact that Worcester has practically no alleys, the average time per house collection is 1.65 minutes (maximum 3.9, minimum 0.4).

Separate Collection of Garbage

The rules of the Board of Health require "the individual householder to provide a suitable water-tight covered receptacle to keep garbage and swill until the same is removed by the city scavengers. This receptacle shall be kept covered at all times; it shall be kept on the ground floor and be convenient of access. No person shall deposit in the garbage any tin cans, water (dish water not excepted), ashes, glass, sweepings, oyster or clam shells, sawdust, cork dust, old boots or shoes, dead animals, etc." These rules have been quite well understood, and Worcester's garbage has, in consequence, been quite clean.

The garbage as collected is hauled to the Home Farm, weighed, and fed to a herd of 2,000 to 3,000 swine. As this system developed from small beginnings, the old farming methods were followed to within quite recent times. With the growth of the city these methods gave rise to considerable complaint because of odor. As a result, a commision was appointed in 1914 to investigate and report. This commission, after investigating all methods of disposal concluded: "That disposal by feeding is the most economical method; that the greatest intrinsic value of the garbage, the feeding value, is made use of; that the garbage of Worcester can not only be disposed of without cost, but that the revenue from the sale of hogs has almost been sufficient to pay for collection."

Operation of Piggery

The following description of the operation applies to Worcester's garbage disposal plant as now operated: The garbage as it comes to the farm is neither washed nor steamed. Washing is uneconomical, because so much food mtaerial is washed away and wasted; it is unnecessary, since no material advantage is gained thereby. Cooking or steaming the garbage has been found by experience to be bad, since the garbage is thereby made more acid than it ordinarily is, and substances are incorporated in the food which are harmful to the hog and which would not be eaten in the raw garbage. A hog is more capable of picking over and culling garbage than any man or machine can be.

To inoculate against cholera the entire stock is treated by the so-called double-treatment method (virus and serum). Pigs 5 to 6 weeks old are inoculated with serum only. This treatment carries them for about seven weeks, when, at a weigh of about 40 to 50 pounds, they are given the double treatment (virus and serum).

Feeding Platforms

After six months the pigs which have grown to shoats are turned out into hog lots (100 pigs to about three acres), with out-of-door feeding platforms made in 8 x 8 ft. section of 2 in. plank. These are mounted on skids, and have a half-round timber on two sides, to prevent the garbage being pushed off. The cost per section was $7, with farm labor. Several sections are placed end to end, and when the ground around the platforms becomes fouled, the sections are skidded to another location and the ground at the former location plowed up. By this means the garbage trampled into the ground is kept from decaying and producing foul odors. The platforms are shovel cleaned daily, and the material removed is composted or buried. The hogs are kept for about fifteen months, when they are sold. They then weigh 250 to 300 pounds. The last lot sold (May, 1917) brought 16.35 cents per pound on the hoof, or 21 cents per pound dressed.

The pens are cleaned out daily. The cleanings are carted away to the compost heap, which is enclosed by concrete walls. The cleanings, when not properly handled, may give trouble from odor. The commission already mentioned experimented with this material and found that when composted in layers, with an equal volume of dry top soil, the rotten manure odor was wholly destroyed, and only a slight musty odor remained after ten days. The cleanings are quite wet, and unless spread alternately in fairly thin layers with dry soil it takes a much longer time to mineralize the odor-giving substances. Objectionable odors may be carried a considerable distance when uncomposted material is spread on the ground as fertilizer, while the composted material is unobjectionable.

Since the bad odors are probably highly nitrogen ous, composting by retaining these substances and mineralizing them would tend to increase the fertilizing value of the manure. About five cords of cleanings are produced daily (1,500 to 1,600 cords per year), and have a value of about $4 a cord as fertilizer at the farm. The Home Farm has never bought fertilizer in any material quantity for its farm land or truck garden, and the scavenger department has never been credited with the value of the pig manure from the piggeries. There are two caretakers in each piggery except No. 11, which has one. One caretaker can care for about 250 to 300 pigs a day—feed them, bed them, and clean out the pens.

The out-door hogs are utilized in cleaning off the scrub from waste land and improving it. They chew and rip off the bark of practically all deciduous trees, and thus kill them, but coniferous trees are not touched. After chewing and stripping the bark they burrow around the roots, chew this bark, and uproot the smaller stumps. In a remarkably short time (about two seasons) the scrub disappears, and only the larger stumps must be pulled out before plowing is possible. Most of the cleared land of the Home Farm has thus been cleared and made into a very productive farm. Hog growers claim, and it has been the experience at Worcester that such scrub acts somewhat as a tonic for the hogs and keeps them in good condition.

Cost of Operation

Including the years 1902 and 1910, which showed a clear profit over and above the cost of collection, the average net cost of disposal per year for nineteen years was $10,169, or $0.074 per capita per year. The total cost of collection and disposal per year is $60,435. About 1,500 swine are sold each year, and, with the present price of pork, will bring about $40 each, or a total of $60,000. This will just about pay for the cost of collection and disposal.

The feeding method is very plastic, and no part of the plant is idle or running below capacity part of the year. When the quantity of garbage becomes less, hogs are sold off; and as the quantity increases, the herd increases to take care of it. In winter there are about 2,000 swine on the farm and in summer 3,500. About 100 to 150 pigs, depending upon size, will consume one ton of garbage per day.

Concreting Methods on the Grand Trunk Pacific Elevators

IN building the elevators and storage tanks of the Grand Trunk Pacific Railway at Fort William, Ontario, the cement used was handled from vessels in bulk cargoes, and it was necessary to provide ample warehouse facilities to hold it until wanted on the work. A cement shed capable of storing 12,000 barrels of cement was connected with the various cement mixing plants by means of railroad tracks on which Vulcan locomotives and dump cars were operated. Sand and gravel for concrete was dredged from Lake Superior and unloaded from barges at a temporary dock 2,000 feet long by clam shell derricks. Travelling hoppers received these materials from a whirley, and in turn loaded the trains of side dump cars. The concrete mixing plant consisted of four No. 2½ Smith mixers and Lidgerwood hoisting engines located in two batteries at each end of the elevator. Four hoist towers and hoppers were constructed and necessary track was laid early, so that when the work was ready for concreting to begin, the mixing plant was completely installed. This plant handled during the course of construction 60,000 cubic yards of concrete, and its efficiency is evidenced by the fact that as much as 800 yards was mixed and placed in a single day. Two million feet of pine lumber was used for forms and moulds. The steel bars for reinforcing concrete in various parts of the work amounted to 2,500 tons and of quality demanded by the Steel Manufacturers' Standard Specifications. Round bars were used in girders and floor slabs. Horizontal reinforcing in the concrete tanks consisted of flat steel bands and, in placing, sufficient lap was allowed to develop the necessary strength of the joints. In the concrete columns supporting the working house bins spiral reinforcing was used, which was made of ½-inch steel wire forming a helix of 41 inches diameter.

Want Wider Road

A deputation from Etobicoke Township recently waited on the Minister of Public Works, Hon. Finlay Macdiarmid, with the request that the Toronto-Hamilton highway be widened in Etobicoke to 56 ft., with an open drain, instead of as at present proposed, 50 ft. and a tile drain.

Mainly Constructional

East and West—From Coast to Coast

The Ontario Department of Highways recently started work on the Kingston Road in the neighborhood of Whitby.

The Toronto Coal and Dock Company, Ltd., has been incorporated, with a capital of $100,000. The head office of the concern will be at Montreal.

The sum of $75,000 is included in the Ontario estimates for work on Collingwood harbor. Operations will be commenced as soon as an elevator, which is being erected at that point, is completed.

The Ontario Government has contributed $10,573.44 to the County of Perth, as its share for the construction and maintenance of the county roads for the year 1917, under the Ontario Highway Act.

A good roads convention was held at Penticton, B.C., on September 6 and 7, at which delegates were present from Vancouver and interior towns. The primary object of the convention was to boost the Canadian national highway project.

At a recent meeting in Victoria, B.C., the Trades and Labor Council endorsed a resolution of the Kamloops Chamber of Commerce asking the Dominion Government to establish plants for handling iron deposits and for their conversion into steel.

Hon. Finlay Macdiarmid, Minister of Public Works for Ontario, and Hon. G. Howard Ferguson, Minister of Lands, Forests, and Mines, recently went to Ottawa to inspect the new Ottawa-Prescott highway with the members of the Highway Commission.

The road-building operations of the New Brunswick Department of Public Works are successfully proceeding in various parts of the province. Motors are employed practically all the time. The Geary road, in Sunbury County, is being widened to 24 ft. and heavily surfaced with gravel.

That the Algoma Steel Corporation has had a prosperous year is indicated by the financial statement of its holding company, the Lake Superior Corporation. The company's earnings for the year ending June 30 were $5,323,004. This compares with a total of $3,503,471 the previous year.

The value of building permits issued in the city of Woodstock, Ont., for the month of August amounted to $16,883, an increase of $2,917 over the corresponding month last year. For the first eight months of the year the total is $79,027, as compared with $75,623 during the corresponding period last year.

According to report, a movement is on foot to establish in Toronto a bureau of industrial and scientific research, to which manufacturers may bring their problems for solution. Prof. J. C. McLennan, of the Department of Physics, University of Toronto, is in England making a study along these lines.

The new oil field in Mosa Township, Ont., appears to hold forth prospects of good returns. Sixteen holes have struck oil, and some of them are actually producing. Since last April one on the line between the fifth and sixth concessions of the township has been flowing more than 60 barrels a day.

Although citizens have been using the Bloor Street viaduct in Toronto it is not officially open for pedestrian traffic, and they have merely been doing so by the permission of the contractors. Some minor work has yet to be completed, and it will probably be another week or two before the structure is handed over to the city.

The improved position, both financial and physical, of the P. Lyall & Sons Construction Company has resulted in the directors declaring an initial dividend on the common stock of 2 per cent. for the quarter ending September 30. The company's earnings are apparently very satisfactory, and the outlook is said to be very bright.

The Shaft and Tunnel Contract Company have obtained letters patent under the Ontario Companies Act, with a capital of $40,000, and are locating their head office at Toronto. The firm propose to carry on the business of general contractors and to undertake engineering works of all kinds, including general mining operations.

Building permits issued in Montreal during the month of August number 148, and are valued at $290,168, as compared with 181 permits, at a value of $601,340, in the same month last year. For the first eight months of the year the total is 1,172 permits, valued at $3,601,707, as against 1,352, at a value of $3,581,554, in the corresponding period in 1916.

Under a recently-completed agreement with the city of Vancouver, South Vancouver has been given direct connection with the high pressure mains of the city system. This does not mean, it is stated, that the district will get any better pressure, but it is hoped that it will mean a material reduction in operating expenses for the municipality.

Since the embargo on stone was lifted the Toronto-Hamilton Highway Commission has been receiving an average of 450 tons of stone per day, with the result that work is rapidly progressing. At the present time the commission has only one mixer in use, but in a few weeks it is expected there will be three mixers in operation, so as to ensure the completion of the highway this year.

In the month of August there were 52 building permits issued in the city of Vancouver, valued at $54,424, while in the same month last year the number of permits was 36 and the value $625,879. The total number of permits for the first eight months of the year was 359, at a value of $385,920, as compared with 296 permits, valued at $1,216,384, during the corresponding period in 1916.

The value of the building permits issued in the city of Regina, Sask., during the month of August was $164,670, and for the first eight months of the year the total is $330,670. During the first eight months last year the total was $192,800, giving this year a lead of $137,870 over the corresponding period in 1916. The largest building for which a permit was issued last month was the new Union Bank building, costing $86,000.

Work is progressing on the addition to Shed 29 on the St. Charles River side of the Louise Embankment, for the Quebec Harbor Commissioners. This extension is being made to correspond with the increase in capacity of their grain elevator, which is being doubled. The shed addition, when completed, will be 750 ft. long by 75 ft. wide. It is being built entirely of fireproof material, and, with the grain galleries from the elevator running over it, four large steamers will be able to load simultaneously, on a wharf frontage of 2,000 ft. The water at this point is 35 ft. deep at low tide, so that very large ships can dock without risk. The work is to be completed by June 1, 1918, and will cost approximately $350,000.

Personals

Mr. W. H. Yeandle, Jr., M.E., recently visited Porcupine on behalf of the United States Smelting, Refining, and Mining Exploration Company.

Mr. Raould Rinfret, Q.L.S., D.L.S., Mem.Can.Soc.C.E., has been engaged by the city of Shawinigan Falls as municipal engineer. Mr. Rinfret has been in private practice for thirty years.

Mr. Douglas Mutch, mining engineer, of the Hudson's Bay Mines, has been appointed by the shareholders of the Temiskaming Mines to make a third investigation of the Temiskaming property.

Capt. Evans, civil engineer, who was formerly employed by the Canadian Pacific Railway at Fort Steele, B.C., recently received promotion to his present rank and was invested with the Distinguished Service Order.

Lieut.-Col. J. S. Dennis, president of the Canadian Society of Civil Engineers, will be in charge of a big campaign in the city of Boston, Mass., to obtain recruits for Canadian and British regiments. This campaign has been originated since the arrival of Brigadier-General W. A. White, in charge of the British recruiting mission.

Obituary

Mr. Malcolm G. McKinnon, of Graham, Ont., died recently at St. Joseph's Hospital, in Port Arthur. Mr. McKinnon was well known in the latter city, where he resided for upwards of ten years, carrying on a building and contracting business.

Flight-Lieut. Lindsay Drummond, of Toronto, who was previously reported missing, is now reported killed in action. He graduated from the Royal Military College, Kingston, in 1914, and went overseas with the first contingent in an engineer's battalion. He was later trasferred to the flying corps.

Sergt.-Major Scott Bartleman, formerly of the 111th Battalion, is reported killed in action. Deceased was born in Scotland 33 years ago. When he came to Canada he located at Galt, Ont., where, after a short time, he was appointed secretary of the Board of Works and later superintendent of the waterworks department.

Mr. James P. Beck died on September 8, at the Presbyterian Hospital, in Chicago. At the time of his death he was general manager of the Portland Cement Association, with headquarters in Chicago. Mr. Beck was only 31 years of age. He was a graduate of the University of Illinois in 1907, with the degree of A.B. in L. and A. Following this he became associated with the Universal Portland Cement Company, of which firm he was later elected president.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Finch, Ont.
The United Counties of Dundas, Stormont, and Glengarry intend to build sixty miles of County Road by contract. Contracts to be awarded at the October session of the Council until noon, October 1st. J. G. Cameron, County Road Supt.

Three Rivers, Que.
Work will be started immediately on reservoir and pumping station for the City Council. Engineers, R. S. & W. S. Lea, 10 Cathcart St.

Windsor, Ont.
Plans have been prepared for a sewer extension estimated to cost about $28,300 on Moy and Hall Streets, from Giles Blvd. to Essex Terminal Tracks, for the City Council. Engineer, M. E. Brian.

CONTRACTS AWARDED

Downie Township, Ont.
Wm. Connelly, care of Clerk, P. Smith, R. R. No. 3, Stratford, has the general contract for drainage system costing $3,500, for the Township Council.

Galt, Ont.
The Standard Paving Co., Ltd., Central Chambers, Ottawa, have the general contract for pavement on Dickson Street from Waies to Wellington, costing $8,860, for the City Council.

Sandwich, Ont.
The Chick Contracting Co., McDougall St., Windsor, have the general contract for sewer pipe for the Town Council.

Windsor, Ont.
The Chick Contracting Company, McDougall St., have the general contract for sewer pipe for the City Council.

Merlo, Merlo & Ray, 296 Windermere Rd., Walkerville, have the general contract for re-surfacing pavement on Bruce St. at a cost of $14,467, for the City Council.

The Cadwell Sand & Gravel Co., Ltd., 84 Sandwich St. W., have the contract for pavement on Cataraqui from Mercer to Marentete, costing $6,927, for the City Council.

The Chick Contracting Co., McDougall St., have the general contract for sewer costing $4,100 for the City Council.

Yamachiche, Que.
Alexandre Carrier, Ste. Tite, has the general contract for $20,000 macadam road to Village from Notre Dame St., for the Village Council.

Railroads, Bridges and Wharves

Kent County, N.B.
Tenders are being received by the minister, P. J. Veniot, until Oct. 5 for the erection of the St. Nicholas River bridge two covered Howe truss spans of 183 concrete and granite masonry substructure, earth and stone embankments for the Department of Public Works, Provincial Government.

Oakbank, Man.
Tenders received by the secretary-treasurer, C. Christopherson, until noon, September 22, for the erection of a 60 ft. pile and a 52 ft. pile bridge for the Municipal Council of Springfield. Plans and specifications at office of Highway Commissioners, Parliament Bldgs., Winnipeg.

St. John West, N.B.
Tenders being received by the secretary, R. C. Desrochers, Ottawa, until 4 p.m., September 25, for dredging 23,000 cubic yards of clay, sand and gravel for the Department of Public Works, Dominion Government. Specifications with the secretary and office of MacLean Daily Reports, Ltd., 345 Adelaide W., Toronto.

Shawinigan Falls, Que.
Tenders are being received for the erection of a steel and concrete bridge between here and Ste. Flore for the Municipal Council. Plans and specifications with the city engineer, Raoul Rinfret, and the Department of Public Works and Labour.

CONTRACTS AWARDED

Halifax, N.S.
S. M. Brookfield, Ltd., 58 Granville St. or Liverpool Wharf, have the general contract for $12,000 storehouse building for the Department of Navy, Dominion Government.

Pierson, Man.
Sam Brown, Bank of British North America, Winnipeg, has the general contract for reinforced concrete abutments, etc., for the Municipal Council.

St. George, N.B.
A. E. Smye, Alma, has the general contract for canal bridge for the Department of Public Works, Provincial Government.

Stonewall, Man.
David Wood, care of secretary-treasurer, V. W. McFarlane, has the concrete contract for concrete bridge for the Highway Commission, Provincial Government, Parliament Buildings, Winnipeg.

Public Buildings, Churches and Schools

Estevan, Sask.
The Town of Estevan and Rural Municipalities contemplate the erection of a hospital estimated to cost $50,000.

Glenwood, Man.
School District No. 382, Lily, contemplate the erection of a $3,000 school. Municipal clerk, J. W. Breakey, Souris.

Montreal, Que.
The Roman Catholic School Commissioners, 87 St. Catherine W., contemplate erection of a school for St. James Parish.

Montreal North, Que.
Tenders are being received by the architect, Arthur St. Louis, 80 St. Gabriel St., Montreal, for the erection of one or two schools costing $100,000, for the Council, City Hall, Montreal North.

Myrnam, Alta.
Tenders are being received by the secretary-treasurer, R. M. Romanisk, until noon, September 25, for the erection of a frame school fofr the South River School District No. 3322. Plans and specifications with the Department of Education.

Toronto, Ont.
The Seventh Day Adventists are erecting a $7,000, one-storey, stucco and brick church on Awde Street. Superintendent of construction, J. H. Walker, 234 Concord Ave.

Woodruffe, Ont.
The Woodruffe Canoe Club contemplate erection of a club house. President, J. Bower Lyon.

CONTRACTS AWARDED

Consort, Alta.
A. McDougall, Grain Exchange Bldg., Calgary, has the general contract for $15,000 school for the Consort Public School District.

Halifax, N.S.
The following contracts have been awarded in connection with the erection of a $25,000 abattoir for the City Council:—Electrical work, J. Starr Son & Co., Granville St.; plumbing, Michael Day, 73 Cornwallis St.; painting, Walsh Bros. Ltd., 230 Hallis St. The general contractor, Falconer McDonald, St. Paul Bldg., will carry out the masonry, steel, carpentry, roofing and plastering.

Lamont, Alta.
W. O. McArthur, 11607-95 A St., Edmonton, has the general contract for $5,500, one-storey, brick veneer addition to school for the Lamont School District. Architect, E. W. Morehouse, Williamson Block, Edmonton.

London, Ont.
The Brantford Roofing Co., Ltd., Sydenham St., Brantford, will supply asbestos and shingle rofing for school for the School Board.

Eggett & Co., 336 Ridout St., have the plumbing and heating contracts for $20,000, two-storey, interlocking tile and brick nurses' home for the London Health Association.

Maisonneuve, Que.
Carrier & Frere Co., Ltee., 31 Laurier Ave. E., Montreal, have the contract for windows and doors for $200,000, three-storey, structural steel, stone and brick school for the Roman Catholic School Commissioners, 87 St. Catherine St.

Montreal, Que.
A. Champagne, 2185 Blvd. Pie IX., has the general contract, will carry out all work except electrical, and wants prices on lumber, brick, cement, plumbing, fix-

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Principal Contents

Concrete is Replacing Steel

THE difficulty of procuring steel is being acutely felt in the prairie privinces of Canada—possibly more so than in any other part of the Dominion. This is due to their inaccessibility to the source of supply and the fact that the mills have more work than they can readily handle. In Saskatchewan, for example, the bridge branch of the Department of Public Highways is greatly handicapped on this account, and it is next to impossible for the department to obtain steel for the larger bridge work. Augmenting these difficulties, there is a shortage of lumber, partly due to the big forest fires in British Columbia and partly to the demands of the Federal Government for lumber for the building of ships at the west coast. Again, the municipalities in the province engaged in the building of culverts and small bridges are making requests to the department for lumber to help them out, so that the officials are hedged around with difficulties, and, while they have no intention of ceasing work, their efforts to complete work in hand are greatly handicapped.

Here, as we see it, the field for concrete is widening. There is no shortage of cement, and the difference in the cost of concrete and steel structures is now apparently almost negligible, or, if anything, in favor of concrete. We have before pointed out the action of one of our Canadian railway companies, which, after obtaining legal permission for the erection of a steel bridge, altered its plans and decided to build a concrete structure. Even yet, however, despite the widespread publicity campaigns carried out by the cement interests, many do not seem to realize the advantages of concrete as a substitute for steel.

Cities Are Not Absolved From Financing Rural Roads

ROAD-BUILDING in Canada, at its present stage, is an undertaking which apparently must come under the control of the provincial governments to a great extent, if anything like a well-balanced development is to result. In each province a department has been formed to exercise a certain amount of supervision over this important work, and upon the efficiency of this department depends very largely the progress which will be made throughout the whole area under its jurisdiction.

One of the biggest problems in a road-building scheme is its financing, so as to produce an equitable distribution of the necessary expenditure. Provincial aid is granted to rural districts in most cases, provided they comply with certain standards and conditions. And this is right, for progress in road-building, provided it is carried out under well-balanced regulations, tends towards the development of the province as a whole. Few counties, or other rural communities, can bear the whole cost of an extensive scheme of highway construction. Nor is it to be expected that they should. In the first place, even though they may be financially capable of doing so, justice demands that they should not be called upon to bear the whole expense of an undertaking from which other communities derive a large share of the benefit. For instance, the improvement of roads in the rural district adjacent to a town or city is a distinct advantage to that municipality. The farmers can get to town quickly and easily and they do so in larger numbers and with greater frequency. As a result, they can afford to market their products cheaper, and at the same time they transact more business with the retail tradesmen and leave a considerable amount of money with them. The banks, too, will do more business, the post office receipts will be larger, and a greater volume of freight will be brought into and sent out from the town by rail—all of which will mean greater prosperity for the town and its people.

Added to this is the direct advantage which comes to the townspeople particularly automobilists of having good road connections with outside points, not to speak of the pleasure of comfortable motor trips along smooth roads. Then, too, more healthful and pleasanter suburbs may spring up, with a resulting development of the city or town.

All of this militates against the argument that when good roads are built in rural communities the farmer should pay for them. The farmer certainly derives great benefit and should subscribe his share. But he should not be made solely responsible for the roads in the vicinity of a town or city; the latter must do its bit, and it is the part of the provincial government to make an equitable arrangement, provided the city authorities are not progressive enough or fair enough to contribute their share on their own initiative. We do not mean to suggest by this that the highway construction work in the vicinity of the populous centres should be taken out of the hands of the county, or other rural subdivision, but that they should be given such financial assistance as is right, provided they are willing to build roads of a sufficiently high standard to be of real benefit to the town or city concerned and to the province as a whole.

In Ontario, provincial legislation provides for a scheme, which, if not ideal, certainly seems to embody the correct theories. Under the system arranged, the city may co-operate with the county in the building of a better type of road in what may be termed the suburban area. The procedure is for the county council to make application to the government requesting that a commission be appointed to deal with the roads in the vicinity of the city, and if, after consulting the city, the department of highways considers the action justified, the local councils select their representatives and a commission is formed for this purpose. The distribution of the cost is then 30 per cent. for the city, 30 for the county, and 40 for the province. In this way the city helps to build and maintain suburban roads of a better type than the county could possibly afford to undertake, and proper provision may be made for the accommodation of the denser traffic which naturally accumulates on highways in the neighborhood of populated centres.

The afternoon of Thursday, Sept. 20, saw the consummation of one of the world's greatest engineering feats, when the central span of the Quebec Bridge was finally bolted in position. It was 5.15 a.m. on Monday, Sept. 17, when the span was floated clear of the false work at Sillery Cove. At 8 a.m. the mooring trusses were lowered to their vertical position, and the span was finally centred and the lifting chains lowered at 8.05. Jacking started at 9.10, and at 10.28, at the end of the second full lift, the scows floated free. The span was raised 24 ft. on Monday, 44 ft. on Tuesday, 52 ft. on Wednesday, and 30 ft. on Thursday.

Building Statistics

A FALLING off in the amount of building in the thirty-five chief cities of Canada is indicated in the table below, which records the building permits issued for last month and compares their value with that of those issued in the corresponding month last year. Reviewing the situation as a whole, a decrease of 24 per cent. is observed. The Provinces of Nova Scotia, Quebec, Manitoba, and Saskatchewan have issued permits of greater value in August of this year than the same month last year. The other provinces, however, show decreases varying from 23 per cent. to 89 per cent. The two chief cities—Montreal and Toronto—have issued fewer permits this year. An outstanding feature is the apparent return of Western cities to normal conditions — Winnipeg, Moose Jaw, Saskatoon, New Westminster, and Victoria—all of which show a very considerable advance. The largest individual increase was in Fort William, where the value of building permits last month was 700 per cent. in excess of the value of August last year.

Estimated Cost of Building Work, as Indicated By Building Permits Issued in Thirty-five Cities

City.	August, 1917.	August, 1916.	August, 1917, compared with August, 1916. Increase (‡). Decrease (*). Amount.	Per cent.
Nova Scotia	**$ 131,171**	**$ 107,366**	**‡$ 23,809**	**‡ 22.15**
Halifax	90,000	93,516	* 3,516	* 3.76
Sydney	41,175	13,850	‡ 27,325	‡179.29
New Brunswick	**22,595**	**41,120**	*** 18,525**	*** 45.06**
Moncton	11,895	17,870	* 5,975	* 33.44
St. John	10,700	23,250	* 12,550	* 53.55
Quebec	**891,830**	**804,659**	**‡ 87,171**	**‡ 10.83**
Maisonneuve	17,700	38,000	* 20,300	* 53.42
Montreal	290,168	600,980	* 310,812	* 51.72
Quebec	521,418	114,819	‡ 406,599	‡354.12
Sherbrooke	23,600	13,800	‡ 9,800	‡ 71.01
Three Rivers	27,175	7,175	‡ 20,000	‡278.15
Westmount	11,769	29,885	* 18,116	* 60.62
Ontario	**1,680,717**	**2,315,442**	*** 634,725**	*** 23.09**
Brantford	10,975	101,470	* 90,495	* 89.18
Fort William	262,100	33,325	‡ 228,775	‡686.49
Guelph	9,525	4,865	‡ 4,660	‡ 95.79
Hamilton	185,325	356,695	* 171,370	* 48.04
Kingston	17,947	25,063	* 7,116	* 28.39
Kitchener	32,390	26,402	‡ 5,988	‡ 22.68
London	31,255	107,985	* 76,730	* 71.07
Ottawa	67,750	118,750	* 51,000	* 42.95
Peterborough	3,450	12,035	* 8,495	* 70.59
Port Arthur	7,290	180,755	* 173,465	* 95.99
Stratford	36,311	19,975	‡ 16,336	‡ 81.78
St. Catharines	79,003	91,499	* 12,496	* 13.66
St. Thomas	10,415	7,950	‡ 2,825	‡ 37.22
Toronto	850,801	1,105,318	* 254,517	* 23.02
Windsor	76,090	123,715	* 47,625	* 38.49
Manitoba	**251,618**	**224,150**	**‡ 27,468**	**‡ 12.25**
Brandon	29,368	60,700	* 31,332	* 51.62
Winnipeg	222,250	163,450	‡ 58,800	‡ 35.98
Saskatchewan	**237,020**	**110,450**	**‡ 126,570**	**‡114.59**
Moose Jaw	51,250	9,200	‡ 42,050	‡457.07
Regina	164,670	97,250	‡ 67,420	‡ 69.33
Saskatoon	21,100	4,000	‡ 17,100	‡427.50
Alberta	**36,700**	**83,900**	*** 47,200**	*** 56.26**
Calgary	27,000	32,500	* 5,500	* 16.92
Edmonton	9,700	51,400	* 41,700	* 81.13
British Columbia	**68,544**	**633,279**	*** 564,735**	*** 89.17**
New Westminster	4,915	4,650	‡ 265	‡ 5.70
Vancouver	54,424	625,879	* 571,455	* 91.30
Victoria	9,205	2,750	‡ 6,455	‡234.73
Total (35 cities)	**$3,320,199**	**$4,320,366**	***$1,000,167**	*** 23.15**

Reservoir and Pumping Station at Three Rivers

The City of Three Rivers, P.Q., have decided to construct a suction reservoir of a capacity of 500,000 imperial gallons and a new brick and concrete pumping station. The station will be equipped with a considerable part of the machinery now in use in the old pumping station. There will be three motor-driven centrifugal pumps, with provision for one or two gasoline engine driven pumps. The city is supplied with water from a series of wells along the St. Maurice River, the water being pumped direct into the mains. The reservoir is primarily intended for fire protection purposes. Messrs. R. S. and W. S. Lea, of Montreal, are the consulting engineers.

The substructure work of the new Thames river bridge at New London, Conn., which has just been completed, has cost over a million dollars. Three piers were sunk by open dredging, the depth being 130 ft. below water. Another pier is a pneumatic caisson pier with three circular caissons.

A Moderate-Sized Factory in Toronto

Beam and Slab Design—Spread, Continuous and Cantilever Footings—Underground Mixer, Tower and Buggies for Concreting

WHILE not unusual in any respect, the new storage battery plant of the Prestolite Company incorporates good design of a modern character, and is typical of many industrial plants being erected throughout Canada. The Prestolite factory is located on the corner of Elm Street and Centre Avenue, Toronto, and when completed will be devoted to the manufacture of the new storage batteries recently placed on the market by that company. The building is designed on the beam and slab plan, and practically the only out-of-the-ordinary feature was the use of cantilever and continuous beam footings. Foundations of this character were imposed by the proximity of the building to the street lines and adjacent property.

Beam and Slab Floors

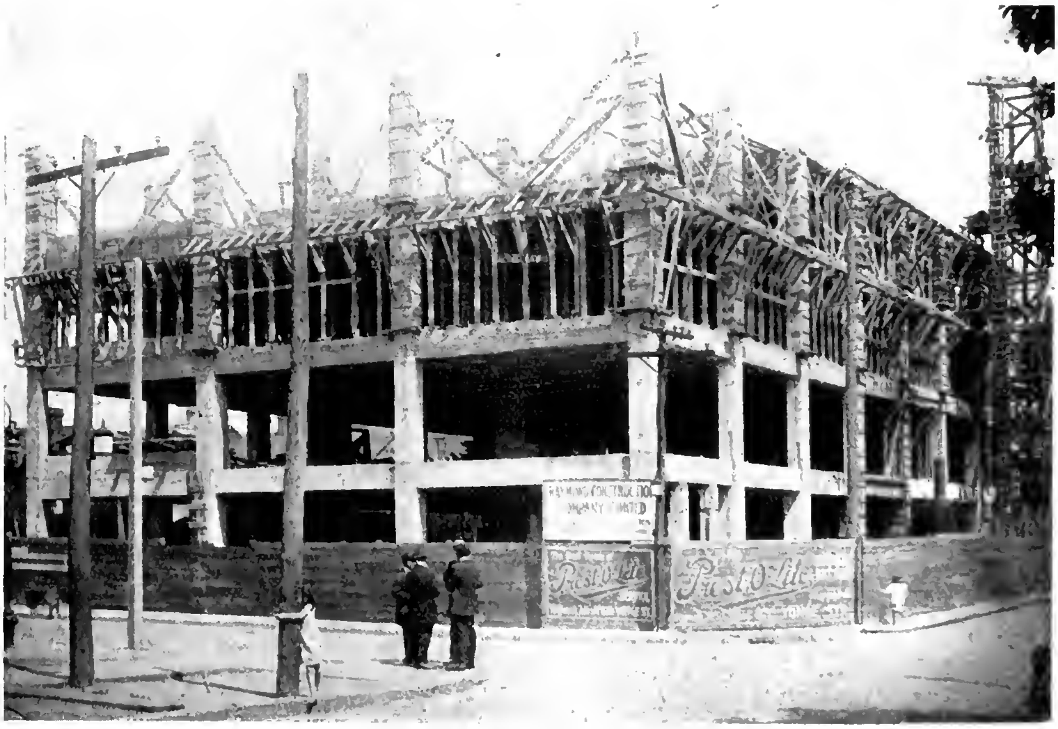
The new plant is rectangular in plan, measuring 119 ft. 3 in. by 70 ft. over all. The length is divided into seven bays, uniformly 16 ft. 9 in. in width. Three bays, each 22 ft, 8 in. wide, are contained in the width of the building. The construction is of reinforced concrete and fireproof throughout. There are four storeys, with a basement under a small portion of the building only. This will contain the boilers, heating appliances, etc. The first storey is 12 ft. high and the remaining storeys are 11 ft.

Each floor is typical, with square columns and beam and slab floors. The columns are spaced at 16 ft. 9 in. centres longitudinally and 22 ft. 8 in. transversely. These columns decrease in size in the upper storeys as the loading diminishes. The floors are designed for 150 pounds per square foot live load, except in one bay on the ground floor, where the designed load is 250 pounds per square foot. This heavy floor is on the wagon way and is over a portion of the basement. The wall columns measure 2 ft. on the face in all cases by 2 ft. 2 in., 1 ft. 8 in., 1 ft. 2 in., and 1 ft. deep on the respective storeys. The typical interior columns are 26 in., 24 in., 20 in., and 14 in. square on the various floors. The girders, spanning approximately 15 ft. in the clear, are 12 in. by 26 in., except on the roof, where they are 8 in. by 24 in. The typical beam is 8 in. by 24 in., with a clear span of, roughly, 21 ft. The roof beams are 6 in. by 20 in. in section. The four floor slabs are 4 in. in thickness, except in one bay, as already noted, where the loading is heavy. The depth in this case is 5 in. The roof slab is 3 in.

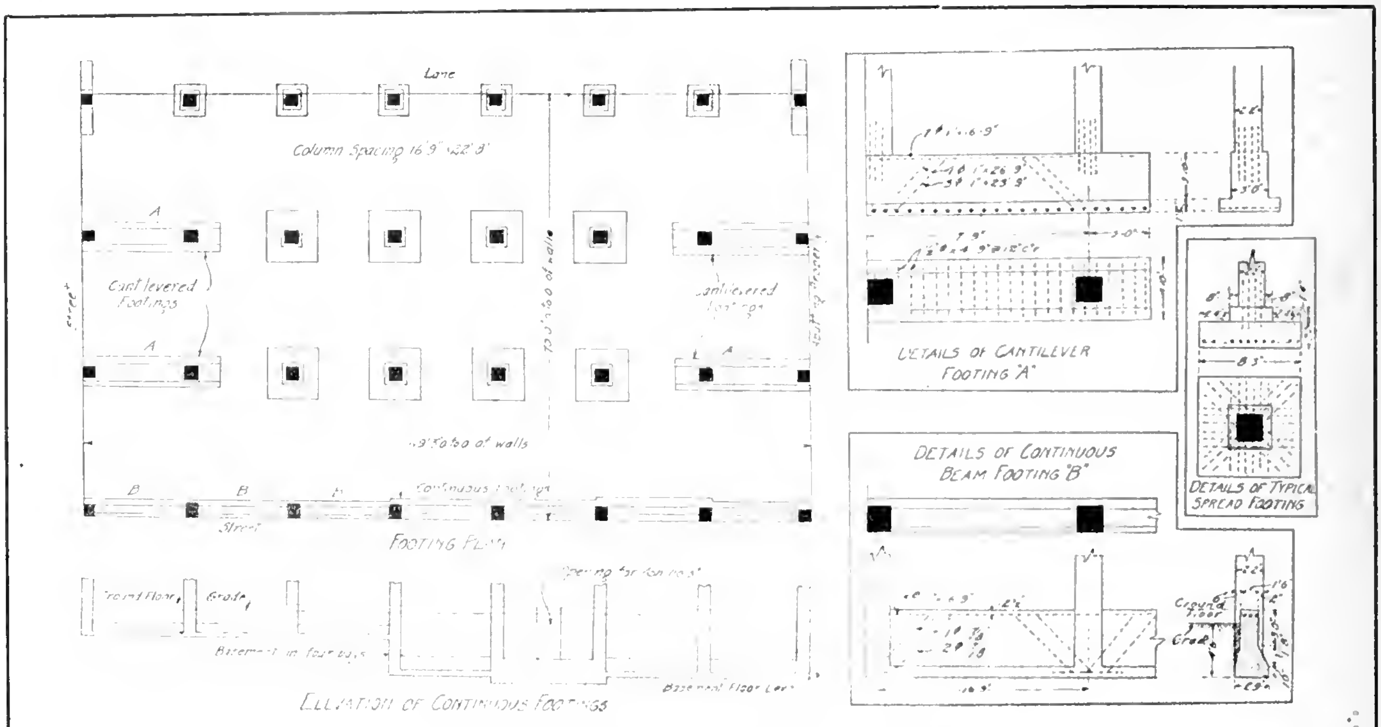
Reinforcement Details

The column reinforcement comprises square hooping and straight bars, the number of the latter depending on the loading. In the girders and beams, Kahn bars and rib bars are used, the typical girder having two Kahn bars and four rib bars, while the typical beam has one Kahn bar and two rib bars. The slab reinforcement consists of straight rib bars.

The exterior panels on three sides are fitted with steel sash, and have a filling of brick, capped with a concrete sill. On the fourth side, which abuts against an existing building, the exterior is entirely bricked in. Rug brick of handsome appearance is used on the street frontages, with face brick on the remaining sides. A concrete stair runs from the basement to the roof, with



Progress view of Prestolite factory.



Plan and details of continuous, cantilever and spread footings.

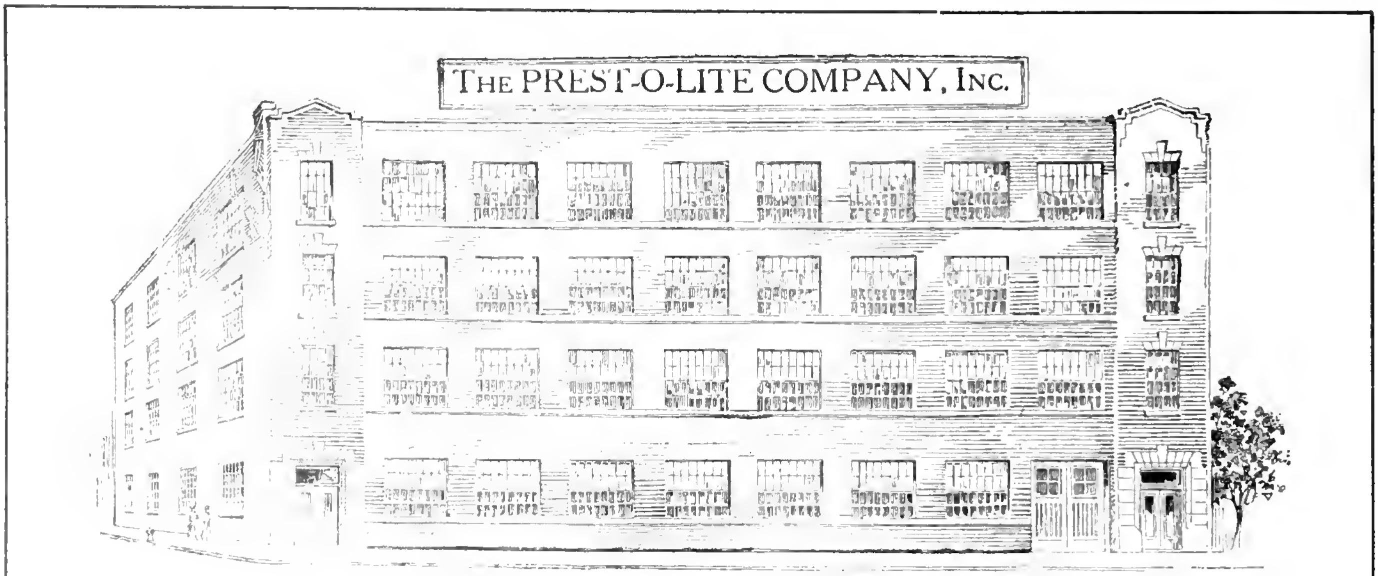
the well enclosed in partitions of Denison interlocking tiles. The elevator well, 18 ft. 8 in. by 9 ft. 9 in., is likewise partitioned off in a similar manner. The roof is tar and gravel on wood sheeting, enclosed with a brick fire wall, coped with tile.

Cantilever and Continuous Footings

There were no difficulties experienced with the foundation work. Owing to the proximity of the building to the street lines and adjacent property, cantilevers and continuous footings were required in some instances. Six columns on the north side and eight interior columns were carried on square spread mattress footings, four-way reinforced. These were carried down, three to five feet below grade, which practically corresponds to ground floor level. The mattresses vary from 7 ft. to 8 ft. 3 in. square. On the south side, beam foundations are employed. Spread footings were out of the question here on account of the impossibility of encroaching over the street line. The drawing shows details of this design. The footings are designed as inverted beams, with Kahn bars and trussed rib bar reinforcing. The footings extend 4 ft. 6 in. to 10 ft. 6 in. below grade. The deeper footings are used at the section where the basement is located. Four pairs of columns are carried on cantilevered footings. The cantilever arm is 22 ft. 9 in. long and 3 ft. by 4 ft. 10 in. in section, with a spread base. The top of the arm is at ground floor level. Straight transverse rods and trussed rods form the reinforcement. All of the footings rest on firm clay.

Mixer Located Under Street

The total concrete yardage in the building is about 1,200 yards. The mix is 1:2:4. Owing to the small



Architect's perspective of factory for the Prestolite Co.

size of the building, an extensive plant was unnecessary. The only difficulty was lack of space on the site, which made it necessary to store materials on the street. No bins were used, as the quantities were small. The concrete was hoisted to the required floor level by a tower and bucket and distributed by hand-buggies. The mixer was located in a pit below the sidewalk, a position which reduced the labor and obviated the necessity of lifting materials from the roadway to the mixer. A batch hopper with a manually-controlled gate, was used to receive the concrete constituents, and allowed batches to be prepared during the mixing of a batch in the drum. After the concrete was poured the tower was used as a brick hoist by fitting a cage and blocking down the bucket.

About 100,000 bricks are being used for panelling, Rug bricks being employed on the street faces. The exterior columns and beams are left exposed, the surface being finished with a cement grout.

One of the illustrations herewith shows the building during erection, while the line drawing was prepared from an architect's perspective. The architects are Hynes, Feldman & Watson, of Toronto, and the contractors are the Raymond Construction Company, Ltd., of Toronto and Montreal.

Factory in Montreal, Que.

for Imperial Tobacco Co. Nearing Completion—Reinforced Concrete 181 ft. by 60 ft., Five Storeys

The Imperial Tobacco Company are completing another reinforced concrete building at their plant, 900 St. Antoine Street, Montreal. The building consists of four storeys and a basement with bridge at the fourth floor level joining the fourth floor level of the adjoining reinforced concrete building. The basement is connected to the adjoining building by a reinforced concrete tunnel. The building is to be used for manufacturing purposes and provision has been made during construction for the installation of machinery on all floors.

The workroom floor is 181 ft. 4 ins. by 60 ft., and the reinforced concrete columns divide it into bays 20 ft. by 22 ft. 8 ins. On each end of the building there is constructed a reinforced concrete enclosed stairway, two toilet rooms, and one elevator. The windows, constructed of solid steel bar sash with plain glass on the street side and wire glass on the yard side, give the maximum amount of natural daylight. The stairways are equipped with Mason treads set flush with the concrete, and have openings on all floors, properly protected against fire with standard tin-clad fire doors. The toilet rooms open onto the workroom floor and are equipped with J. L. Mott Company's sanitary range closet built in place.

Elevator Machine

The elevator machine sets on a reinforced concrete slab on top of the elevator tower; the ropes passing through to the car weights below. The machine is of the direct conected type with a lifting capacity of 4,000 lbs. at a speed of 100 feet per minute. The doorways to the elevator tower are Peelee doors with truckable feature and self-closing device.

The foundations are reinforced concrete built as a continuous mass running around the building, while the interior column settings are of the spread battered type with a grill of steel on the bottom. The interior columns run from 30 in. x 30 in. in the basement, to 16 in. x 16 in. at the roof slab, with 4 ft. 6 in. x 4 ft. 6 in. hoppers at the slab line. The interior, being constructed on the flat slab principle with round rods, and the ceilings being high, 14 ft. 5 in., everything has a very roomy appearance.

The basement floor is concrete, while the other work room floors are built of ⅞ in. pine on 2 in. x 4 in. pine sleepers, well tied down to the concrete slab with galvanized wire. Between the sleepers is placed a cinder filling well tamped into place.

Conduits and Hangers Placed Before Concreting

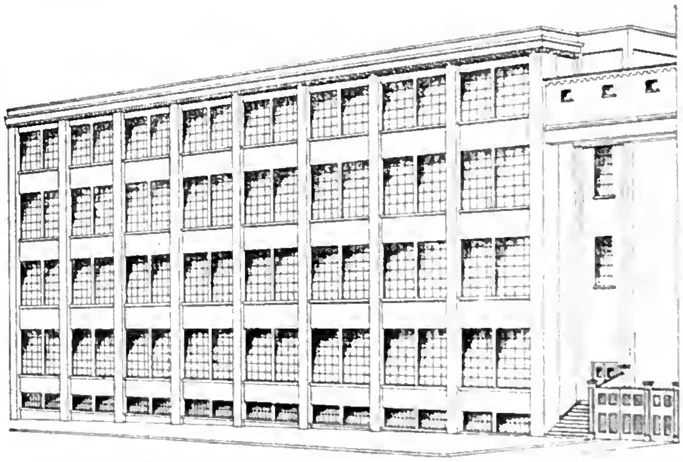
Before concrete was poured all electric conduits, pipe hangers and shafting hanger castings were located. Plenty of conduit outlets and shaft hanger castings were provided to take care of future installation. Conduit outlets were placed in bays 8 ft. x 10 ft., and shaft hanger castings in bays 4 ft. 6 in. x 4 ft. 6 in.

In the end walls, adjoining the stairways and toilet rooms, reinforced concrete ventilating ducts were constructed with openings on all floors. These will be used for venting machines and for forced ventilation.

The interior is equipped with automatic sprinklers throughout and the whole construction is designed with fire-resisting materials, with the exception of the finished workroom floors, which are wood.

Exterior Surfaces Finished

After all framework was removed, the exterior and interior were carefully gone over. All voids and faults were filled in, all ridges and rough places were rubbed down, and a neat cement coat was applied with steel trowels and brushes.



New concrete factory of the Imperial Tobacco Co., at Montreal

The interior is painted throughout with Langmuir's Mill White and Gilsonite paint. The exterior is washed with cement to give a regular color.

The general contractors were A. F. Byers & Co., Montreal. The sub-contractors are: Exterior waterproofing, galvanized iron and roofing, McFarlane-Douglass Co., Montreal; steel sash, Steel & Radiation, Ltd., Montreal; glazing, Pilkington Bros., Montreal; elevators, Otis-Fensom Elevator Co., Montreal; electrical, Montreal Electric Co., and plumbing, heating and sprinkler, L. E. Moulton & Co., Montreal.

The plans and specifications were prepared by the Engineering Department of the Imperial Tobacco Company of Canada, Limited, who also looked after the construction of the building.

Road Costs in Ontario Show Variation

Cost Per Mile Dependent on Local Conditions and Availability of Materials — Selected Cost Data of Representative Work Done in Province

A RECENTLY published report covering highway improvements in Ontario during 1916 contains some cost data which show the variation that is possible in different parts of the province, dependent on local conditions. The cost per mile varies with local conditions, and the cost of each mile of road should be estimated on its own merits. Some counties have an abundance of local stone; in other counties, stone must be imported by rail, with attendant freight charges, and additional cost of handling from the cars. Some counties have large deposits of gravel, and build gravel roads. Some roads may already have had a coating of stone or gravel, which serves as a foundation and requiring only resurfacing; other roads have had little or no previous attention.

A number of districts in Ontario, such as portions of York, Peel, Halton, and Welland, have no local material for road-making. In these cases an entirely new road must be built, often on a clay subsoil, and freight rates on stone must be added—all tending to higher cost, and amounting to from $4,000 to $8,000 per mile.

In other districts, such as Frontenac, Lanark, or Leeds and Grenville, there is an abundant supply of stone on or close to the road, and frequently the task is one of regrading and putting a surface over an old stone or macadam road. In such cases, a cost of $2,500 or $3,500 per mile is an ordinary expenditure.

Certain districts, on the other hand, have an abundant supply of gravel. Many of the roads have been gravelled from time to time and a good foundation has been made. In such cases, the work usually consists of removing the shoulders, improving the drainage, and adding a new surface of gravel—costing from $1,000 to $2,000 per mile for substantial work suited to local traffic.

The following instances have been selected from a number of counties to indicate the various conditions under which work has been carried on:

Lanark

(a) County Roads Nos. 7 and 19, Pakenham Township.

An old stone road originally surfaced in 1905, resurfaced in 1916 with crushed limestone and granite. Length of road resurfaced, 3½ miles; width of stone applied, 7 feet, depth of stone, 3 to 8 inches, depending on condition of road. The stone was not rolled, but ruts were carefully filled as they formed, leaving a good crown on consolidation. Stone was purchased at a cost of $3 per cord delivered and piled near the road, ready for crushing. Crushing, hauling and spreading were done by day labor for $3.50 per cord. The average haul from crusher to road was ¾ mile. In all, 415 cords of stone was used, the itemized cost of the work being as follows:

415 cords of stone purchased at $3 per cord	$1,245.00
Crushing, hauling and spreading 415 cords at $3.50	1,452.50
Trimming subgrade with grader	25.00
Filling ruts during consolidation	13.27
Total cost	$2,735.77
Average cost per mile	$781.65

(b) County Road No. 8, Beckwith Township.

Resurfacing 3 miles of old stone road with crushed limestone. Stone used, 300 cords, spread 7 feet wide, and 3 to 6 inches deep, depending on the condition of the old road. The average haul for the crushed stone was one mile.

Detailed cost of work:

300 cords of stone purchased at $3	$ 900.00
Crushing, hauling and spreading 300 cords at $3.75	1,125.00
Trimming with grader	50.00
Filling ruts during consolidation	28.61
Total cost	$2,103.61
Average cost per mile	$701.20

Wages—Men, $1.75 per day and board; teams, $2.75 per day with board for teamsters and hay for horses.

Frontenac

Road No. 12, Pittsburgh Township, constructed in 1914. Length 2 miles.

The road was originally flat and crooked with poor surface drainage. It was carefully straightened before being surfaced. All work was done by day labor. Approximately 375 toise (3,000 cubic yards) were used, the total cost being $7.58 per toise, or 95 cents per cubic yard.

The cost in detail:

Stone purchased in quarry, 375½ tons at 25c.	$ 93.88
Quarrying, crushing, hauling, and spreading	2,060.41
Rolling, sprinkling and finishing	460.00
Grading	166.72
Guard rail	59.99
Total cost	$2,841.00
Cost per mile	$1,420.50

Prevailing wages in Frontenac County were: Foremen, $3.50 per day; men, $2.00 per day; teams, $4.00 per day; engineers, $3.00 per day.

Leeds and Grenville

Road from Smith's Falls to Jasper, built in 1914 and 1915. Length, 6 miles.

This road traverses rolling country with fair drainage facilities, being principally sandy loam. Prior to construction, very little grading had been done and the road was generally flat and poorly drained. Grading included cutting a number of hills and filling hollows. Weak foundations were strengthened where necessary with fieldstone base. Stone was quarried limestone of good quality. Quarrying and crushing were done by contract, the price for crushing including delivery on the road. The metalled surface is 9 feet wide with an average depth, consolidated, of 8 inches.

Details of cost are as follows:

Grading, including cutting and filling and laying fieldstone base where necessary	$2,175.71
Culverts—	
2—30-in. x 24-ft., corrugated iron	
1—24-in. x 22½-ft., concrete tile	
2—18-in. x 22½-ft., concrete tile	
3—15-in. x 22½-ft., concrete tile	467.92

Stone—

Purchased in quarry	$ 75.00	
Quarrying, 1,567 cords at $2.15	3,369.02	
Crushing 1,506.35 cords at $3.75 (including delivery on road)	5,648.80	9,092.82
Rolling, watering, and finishing		1,138.84
Total cost		$12,875.29
Average cost per mile		$2,146.00

Wages: Men, $1.75 to $2.00 per day; teams, $4.00 per day.

Halton

Road No. 2a, Lots 1-5, Trafalgar Township.

This section of road is over a level country, the subsoil being heavy clay and the drainage somewhat difficult. Two miles of road were constructed of crushed limestone. The stone was quarried, crushed and hauled an average distance of seven miles, by contract, for $1.87 per cubic yard; the County furnishing the crushing outfit. Spreading, rolling and finishing was done by the County.

The stone was laid 9 feet wide and 8 inches deep.

The details are as follows:

3,080 yards of stone at $1.87	$5,759.60
Grading	490.69
Spreading, rolling and finishing	972.95
Fuel for roller	145.89
Supplies	140.83
Lumber for stone bin	33.52
Culvert	158.90
Total cost	$7,702.38
Average cost per mile	$3,851.19

Road No. 4, Nassagaweya Township, Four miles built in 1915.

The road traverses slightly rolling country with a gravelly soil and good drainage facilities. The metalled portion is 9 feet wide and 8 inches deep. A number of hills were cut, hollows filled, the grade widened and 8 concrete tile culverts were placed. Machinery was furnished by the County, and crushing and hauling was done by contract. Crushed fieldstone was used, being hauled from piles in the fields and crushed at the roadside. The average haul was approximately one-half mile.

Details of the cost are as follows:

Grading	$1,351.67
Hauling, crushing and delivering stone	2,946.63
Spreading, rolling and finishing	1,279.97
Fuel and supplies	213.55
Culverts	154.50
Total cost	$5,946.32
Average cost per mile	$1,486.58

Wages: Men, $2.00 per day; teams, $4.00 per day.

Welland

Road No. 23, Townline between Thorold and Pelham Townships, 2.88 miles.

This road carries concentrated market traffic into the town of Welland from the principal intensive farming section of Welland County. It passes over a level clay subgrade where drainage facilities are poor. The road has not been previously metalled. The length completed was 2.88 miles. Average haul for material was 1¼ miles, over heavy clay roads. The road had been previously graded, requiring only light finishing work at the time of construction. The metalled portion consists of crushed limestone laid 9 feet wide, and to give a consolidated depth of 9 inches.

Wages paid on this work were $2.00 and $5.00 per day for men and teams respectively.

Following are details of the cost, which is representative of much of the work done in this county:

Grading	$ 196.20
Tile draining	35.25
7,393.75 tons stone at $1.10 per ton (f.o.b. railway siding)	8,133.12
Hauling stone, spreading, rolling and finishing	4,819.32
Seven tile and other culverts	494.61
Total cost	$13,678.50
Average cost per mile	$4,750.00

Wentworth

Caledonia Road, south of Hamilton.

This is a heavily travelled road, carrying market traffic from a large territory into the city of Hamilton. It was an old stone road, previously graded but in badly worn condition. A number of grades were reduced and the road was widened in places. The metal used consisted of limestone from a commercial quarry at Hagersville, carried to the vicinity of the work by rail; the cost of the stone being $5.25 per cord (equivalent to about $1.10 per cubic yard) f.o.b. the railway siding. The average haul for stone was 4 miles over rough roads. The length of the work was 1¾ miles; stone was laid 9 feet wide, and to a consolidated depth of from 6 to 10 inches, depending on the original condition of the road.

Wages paid on this work were $2.00 per day for men, and $5.00 per day for teams.

Details of the cost are:

523.09 cords crushed limestone at $5.25 f.o.b. railway siding, Glanford	$2,746.22
Fuel, oil, supplies, etc.	206.99
Two corrugated metal culverts	69.00
Labor—hauling, spreading, rolling and finishing	6,707.31
Total cost	$9,729.31
Average cost per mile	$5,560.00

Middlesex

Road No. 9, London to Lambeth. Six miles.

An old gravel toll road in fair condition. The road had been previously graded, requiring only light trimming to restore the old cross-section. Pit gravel of good quality ranging from sand to 2 inches was used, being spread 9 feet wide, with an average depth of 7 inches and consolidated with a steam roller. The average length of haul was 2½ miles. Approximately 215 cords (1,020 cubic yards) per mile was used: the average cost per mile, which is representative of the greater part of Middlesex County work, being as follows:

Gravel in pit, 215 cords, at 55 cents	$ 118.25
Hauling gravel, 215 cords at $4.00	860.00
Spreading	53.75
Rolling	53.75
	$1,085.75

Wages on this work were $2.00, and $4.50 per day for men and teams respectively.

York

Road No. 3, Markham Township, 4¼ miles.

Constructed by day labor, all stone was imported at a cost of $1.30 per ton, f.o.b. railway siding, which price is equivalent to $1.70 per cubic yard. A total of 5,320 cubic yards of stone was used, the metal being 10 feet wide. The work included 5,600 feet of tile drain. The country traversed is rolling, giving good drainage, and heavy grading had previously been done.

The cost in detail:

7,016 tons (5,320 cu. yds.) stone at $1.30 per ton	$9,120.80
Unloading cars	833.24
Hauling stone (average 1¼ miles)	2,069.93
Labor, levelling and finishing	1,257.78
Rolling and watering	524.30
Tools	130.00
Fuel, oil and supplies	230.00
Grading	424.39
Tile draining, 5,600 feet, 4-in. tile	412.51
Total cost of work	$15,002.95
Average cost per mile	$3,530.00

Length of work, 4¼ miles.
Wages paid: Men, $2.00 and $2.25; teams, $5.00 per day.

Lennox and Addington

County Road No. 9, York Road east of Odessa.

This is a section of the heavily travelled York Road, carrying the through traffic between Kingston and Belleville, in addition to heavy local market traffic. The road, originally an important stone military road, had received little repair, the surface being rough and worn out. A deep course of crushed limestone 12 feet wide was applied and finished with a roller. Material was obtained from a quarry in the immediate vicinity, resulting in very low haulage costs. Approximately 3,760 cubic yards of stone was placed on this section of 1¼ miles.

The following is the cost in detail:

Quarrying and crushing	$2,022.92
Hauling stone	623.25
Spreading, rolling and sprinkling	659.70
Tile for culverts	34.75
Total cost of work	$3,340.62
Cost per mile	$2,672.50

Wages: $1.75 to $2.00 per day for men and $3.50 per day for teams.

Prince Edward

Road No. 17B, Point Traverse Road, South Marysburg Township.

This is a moderately travelled road carrying market traffic en route to Picton. A section 2.16 miles in length was constructed in 1915. The road was an old earth road in fair condition. The subgrade was straightened and crowned prior to metalling. Crushed stone from a county quarry was applied 9 feet wide and 10 inches deep, and thoroughly rolled. A total of 4,192 cubic yards was used. The length of haul averaged 1⅛ miles. Wages on this work were $1.75 to $2.25 per day for men and $3.75 per day for teams.

The cost in detail was:

Grading	$ 804.47
Quarrying and crushing	2,180.90
Hauling stone	1,341.29
Spreading, rolling and finishing	817.86
Culverts	92.60
Total cost	$5,237.12
Average cost per mile	$2,425.00

Road No. 1 B, Consecon Road, Hillier Township.

A section of the main travelled road between Trenton and Picton 1.6 miles in length was constructed in 1915. The road before improvement was narrow, low and flat. Before metalling the grade was raised, widened and straightened, two hills were cut and hollows filled. Crushed limestone was obtained from a quarry owned by the County, the average haul being approximately one mile. A total of 2,904 cubic yards was used on the work, the stone laid 9 feet wide and 10 inches deep. Wages paid were $2.00 to $2.50 per day for men and $4.00 per day for teams.

The itemized cost is as follows:

Grading	$1,110.86
Quarrying and crushing	2,261.86
Spreading, rolling and finishing	676.51
Hauling stone	1,027.22
200 feet 12-inch tile drain	126.43
Total cost	$5,202.88
Cost per mile	$3,251.80

Incombustible Houses

As indicating the further developments in the use of concrete in the construction of smaller buildings, the following item taken from The Scientific American is of interest:—

"Boards of concrete, with joists, rafters, and stair-frames of the same material, are used in the construction of a novel building in Los Angeles, Cal., the whole being set upon a concrete foundation. Though put together after the manner of a frame structure, the building is as fireproof and durable as the more common types of cement houses, but it requires less material and is lighter in weight.

"The various parts are poured into forms on the ground near the site, and in that way the danger of breakage is eliminated. The clapboards are poured in sets of ten, the forms being securely clamped together, and the cement allowed to harden in them for several days. Then they are taken out and allowed to cure before being set up. This should be done while the preliminary work is going on, such as excavating and laying the foundation.

"The joists, rafters, and other parts are formed in the same manner, and various types of reinforcing are used for each. The boards are reinforced with mesh like chicken-wire, while the timbers have iron rods of varying thickness to strengthen them. These are allowed to project at one end in order to fit into corresponding holes in other timbers, so that the whole framework dovetails. The method of attaching the boards to the 2 x 4's is with nails, and nail-holes are bored into the cement boards before they have set, by running a wire through them. As the cement timbers will not take the nails a strip of wood about an inch and a half thick is wired to the cement scantling."

Toronto's Total Assessment $11,000,000 in Excess of Last Year's

Toronto's total assessment for the present year will amount to $600,000,000, or an increase of over $11,000,000 over last year, according to the estimate of Assessment Commissioner J. C. Forman. The population has increased by about 12,000 during the year, and the total is now said to be 500,000, although the official estimate was 482,000.

Issuing Monthly Stock List

The Sarnia Bridge Company, Ltd., Sarnia, Ont., is issuing a monthly stock list of steel products, which records all the structural steel materials on hand. The range of materials carried varies from the smallest angle to the heaviest sections rolled. Th Sarnia road drag, approved by the Ontario Highway Department, is also handled by this firm.

Air Diffusers and Dewatering Devices

For Activated Sludge System of Sewage Purification—Results of Comparative Tests — Filtros Plates Seem Superior

RESULTS of comparative tests of methods of air diffusion in the activated sludge process and of devices for dewatering the sludge were outlined by Prof. Edward Bartow, Director of the Illinois State Water Survey in a paper presented at the Buffalo meeting of the American Institute of Chemical Engineers. The tests were made at the Sewage Treatment Station of the Survey at the University of Illinois during the first six months of this year. An abstract of Prof. Bartow's paper follows:

Method of Air Diffusion

Four reinforced concrete tanks were remodeled and each fitted with a different air diffuser. The tanks operate on the fill-and-draw system and are 3 ft. 2 in. square and 8 ft. deep. At each filling 350 gals. of sewage were added.

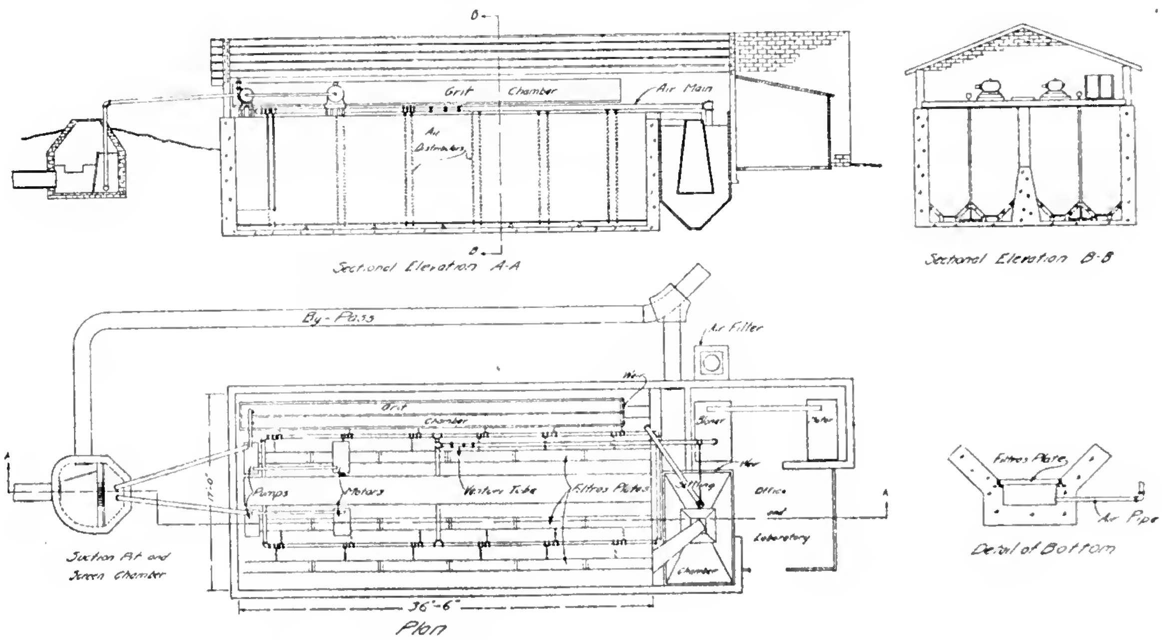
One tank was fitted with a system of perforated pipes having perforations 1/25 inch in diameter placed 2 ins. apart and staggered at an angle of 45 degs. from the top of the pipes. There were about 40 holes in the pipes or 4 to each square foot of surface area. The bottom of the tank is sloped from the centre and sides at an angle of 45 degs., thus forming V-shaped channels of equal size, 1 ft. in depth, running entirely across the tank.

The bottom of the second tank was hoppered from all four sides and a concrete container for wooden-block air diffusers was placed in the bottom of the hopper. The container was patterned after one designed by Nordell and used at Milwaukee in the Nordell aerating tank. The container is a 1-piece casting 2 ft. 8 in. long, 1 ft. 8 9/16 in. broad, and 5 in. thick with a receptacle for the blocks 1 ft. 3 9/16 in. by 2 ft. 3 in. in plan, ¾ in. deep at the edge, and 1¼ in. deep at the centre. The wooden blocks rest upon a series of 13 ridges, ½ in. wide and ¼ in. high that run across the receptacle leaving a ¼ in. space underneath for the air to circulate. The surface of the container was cast on a curve so that the tendency of the wooden blocks on swelling would be to wedge themselves more firmly into position. The basswood blocks used in the experiments were ½ in. thick, 6 in. long, and 2⅛ in. wide. At first, difficulty was experienced in keeping the blocks in position because of the excessive swelling that took place when they were placed under water, and also because they became soft and spongy. Many of the blocks became so curved and twisted that they were discarded. It was found necessary to place strips of heavy galvanized iron on edge between each row of blocks for reinforcement and to close up certain joints with oakum.

Filtros Plates in Two Tanks

Filtros plates of different porosity furnished by the General Filtration Company were placed in two of the tanks. Three plates were used in each tank, covering one-third of the area and forming the bottom of a trough with sides sloping at an angle of 45 degs. The plates of the third tank were marked "fine" because on the basis of dry rating these plates passed 5.8 cu. ft. of air per minute per square foot under a water pressure of 2 in. When saturated with water and passing 2 cu. ft. of air per minute they showed a resistance on a water gauge of 11.4 to 11.8 in. The fourth tank was equipped with plates marked "coarse" which on the same basis passed 12 cu. ft. of air per minute per square foot. When passing 2 cu. ft. of air per minute these plates registered a resistance of 8.8 to 9.0 in. of water pressure.

The tanks were operated during three periods of 15, 20 and 35 days, respectively. Each of the tanks



Elevation and plan of experimental station of the Illinois State Water Survey.

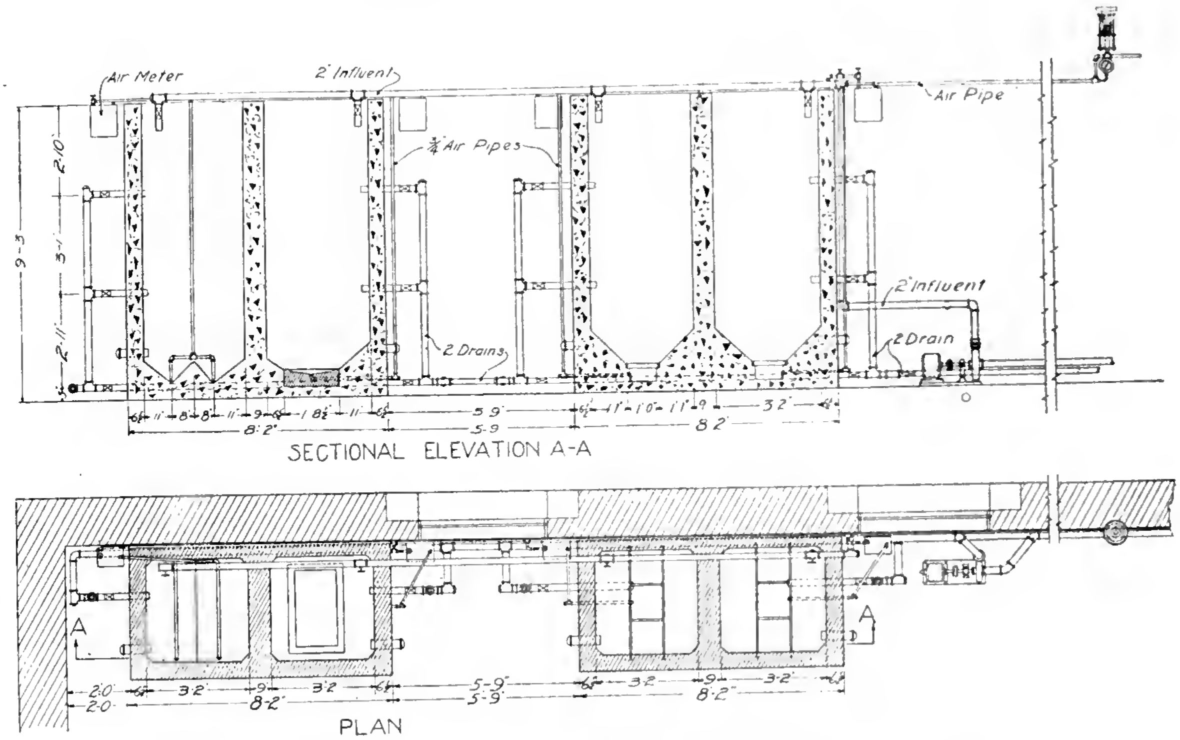
was operated in three aeration periods daily of 510, 300 and 270 minutes with a 2-hour allowance between the periods for settling, emptying and filling. The same amount of air as measured by ordinary gas meters was added to each tank. All conditions were maintained as nearly identical as possible. The sewage was pumped from the main sewer just outside the city limits of Champaign and accordingly was fresh. It was a fairly strong, domestic sewage with no trade wastes. No activated sludge was added to the tanks at the beginning of any of the series of tests.

Sludge Settled for Thirty Minutes

Samples of sewage were taken as the sewage was being pumped into the tanks and samples of effluents were collected at the close of each aeration period after the sludge had been allowed to settle for 30 minutes. The methods of analysis were those given in the 1917 edition of Standard Methods for the Examination of Water and Sewage of the American Public Health Association.

In the first series of tests only the perforated pipes and Filtros plates were used. The series continued only 15 days. The average purification, measured in terms of removal of turbidity, removal of oxygen-consuming capacity, and the production of nitrate nitrogen was greatest in the tanks with the coarser Filtros plates, next in the tank with finer plates, and least in the tank with perforated pipes. Measured in terms of reduction of ammonia nitrogen and sludge accumulation the order was reversed. About 19,000 gallons were treated with 2.5 cu. ft. of free air per gallon.

All four tanks were in operation in the second series of tests, which continued 20 days. Measured in terms of removal of turbidity, removal of oxygen-consuming capacity, production of nitrate nitrogen, and sludge accumulation, the tanks containing Filtros plates gave the best results. The tank with the wooden blocks was next and the tank with perforated pipes the poorest. Measured in terms of reduction of ammonia nitrogen, the tank with the perforated pipes was the best. About 17,000 gallons of sewage were treated with 1.8 cu. ft. of free air per gallon.



Elevation and plan in section of sewage experimental plant at the University of Illinois.

Superior Results with Filtros Plates

The third series of tests, which lasted 35 days, was the most satisfactory. (See Tables I. and II.) There was no sludge present at the beginning and owing to

Table I.—Summary of Results Obtained in the Comparison of Efficiency of Methods of Aeration Measured in Terms of Ammonia Nitrogen, Nitrate and Nitrite Nitrogen, and Oxygen Consumed.

(Parts per million.)

Period 1917.	Ammonia Nitrogen Sewage.	Ammonia Nitrogen Effluents A	B	C	D	Nitrate and Nitrite Nitrogen Sewage.	Nitrate and Nitrite Nitrogen Effluents A	B	C	D	Oxygen Consumed Sewage.	Oxygen Consumed Effluents A	B	C	D
March 27-April 1	21	17	17	18	17	.9	1.2	4.0	3.9	3.9	58	26	19	20	22
April 1-6	17	17	16	16	16	4.7	3.9	4.7	6.1	6.3	46	21	18	15	14
April 6-12	16	11	9	8	9	5.1	4.9	4.5	5.9	7.2	50	26	24	19	26
April 12-17	26	30	29	0	0	.3	.4	.3	6.8	10.2	55	32	26	25	16
April 17-22	21	21	21	0	0	1.2	.3	.0	15.0	16.9	..	..	..	..	..
April 22-27	25	24	23	0	0	1.0	.2	.1	25.8	26.0	..	..	..	..	..
April 27-30	22	30	20	0	0	4.5	.3	.0	23.8	24.7	..	..	..	..	..
Average	21	20	19	6	6	2.5	1.7	1.9	12.6	13.6	52	21	22	20	19
Reduction		5%	10%	71%	71%							60%	58%	62%	63%
Results April 12-30 after Activated Sludge was formed.															
Average	24	24	23	.0	0	1.7	.3	.1	17.8	19.4	55	32	26	25	16
Reduction		0%	4%	100%	100%							41%	53%	54%	70%

A—Tank with perforated pipes.
B—Tank with wooden blocks.
C—Tank with fine Filtros plates.
D—Tank with coarse Filtros plates.

the length of the test at times some of the excess of the accumulated sludge was wasted. No accurate comparison of the sludge accumulation at the end of the series can be made. The maximum amount of sludge was reached last in the tank with perforated pipes. Removal of turbidity and oxygen-consuming capacity was practically the same in all tanks. Measured in terms of removal of ammonia nitrogen and in production of nitrate nitrogen the tanks with Filtros plates were decidedly superior. Ammonia nitrogen was entirely removed in the tanks with Filtros plates after 17 days. Owing to rains nitrate nitrogen was present in the raw sewage during the early part of the series and continued to increase in the tanks containing Filtros plates reaching about 25 parts per million. Practically all of the nitrate nitrogen disappeared from the other tanks. The poor results from the tank with wooden blocks were probably caused by the development of a hole in the tank which prevented the formation of finely divided bubbles. The stability of methylene blue was tested on and after the eleventh day and all effluents from the tanks

Table II.—Summary of Results Obtained in the Comparison of Efficiency of Methods of Aeration Measured in Terms of Turbidity and the Accumulation of Sludge

(Parts per Million)

Period 1917.	Turbidity Sewage.	Turbidity Effluents A	B	C	D	Per Cent. Sludge Effluents A	B	C	D
March 27-April 1	282	48	39	46	46	9	8	8	7
April 1-6	317	9	6	6	6	14	14	12	12
April 6-12	190	9	5	5	5	18	21	18	18
April 12-17	248	7	5	5	5	26	29	25	28
April 17-22	306	5	5	5	5	29	35	34	31
April 22-27	309	5	5	5	5	38	37	44	39
April 27-30	268	5	5	5	5	35	33	36	33
Average	274	13	10	11	11				
Reduction		95%	96%	96%	96%				
Results April 12 to 30 after Activated Sludge was formed.									
Average	283	5	5	5	5	38	37	44	39
Reduction		98%	98%	98%	98%				

containing Filtros plates were stable for 10 days at 20 degs. C. Most of the effluents from the other tanks were unstable. Nearly 30,000 gallons of sewage were treated in each tank with 3.2 cu. ft. of free air per gallon. The sludges in the tanks with Filtros plates settled better and after removal at the end of the series, had specific gravities of 1.013 and 1.022 compared with 1.006 for the sludges from the other tanks.

The results obtained from these comparative tests indicate the superiority of Filtros plates as air diffusers over perforated pipes, such as were used in our tests under the conditions maintained. The wooden blocks were difficult to handle though this was caused in part by the faulty design of our containers. Even in the time they were used there was evidence of considerable deterioration. From the results obtained little, if any, difference could be distinguished between the coarse and fine grades of Filtros plates. With air free from dust and oil there should be little trouble experienced from clogging of plates.

Dewatering of Activated Sludge

Experiments in drying on sand beds were not successful. Owing to the large amount of moisture in the sludge, 98 to 99 per cent., the solid matter obtainable from a foot depth of sludge would be only from ¼ to ½ in., according to the residual moisture content. The fertilizer obtained was more or less impure and of decreased value. The sand beds used were 0.01 acre in area and divided into five compartments. Underdrains were overlain with 10 inches of coarse gravel and 8 inches of sand. The beds were provided with a canvas cover supported on a frame work so that they could be protected during storms. One compartment was allowed to dry after a single filling, another after two fillings and another after three fillings. In no case were the results sufficiently satisfactory to warrant the use of sand beds for the drying of the sludge and the production of a commercial fertilizer.

Experiments with a filter press with leaves 8½ ins. square operating on a fairly concentrated sludge were also unsatisfactory, it being impossible to obtain a cake of good consistency. Further experiments are to be tried with the hope that better results can be obtained.

Through the courtesy of the Koering Cyaniding Co., of Detroit, a rotary filter was obtained. This style of filter is used satisfactorily in filtering slimes in extracting gold and silver by the cyaniding process. The apparatus consists of a cylinder of Filtros plates supported on a perforated steel cylinder, outside of which at a distance of about 1 inch is a solid steel outer shell. The material to be filtered is forced into the interior of the cylinder of Filtros plates, the cylinder is revolved and a cake of sludge is built up on the inside of the plates. The liquid filters through the plates into the space between the cylinders. Air pressure can be exerted from the interior to dry the cake, and from the exterior to loosen it. The plates can be cleaned by back-filling with water. The first trial with a comparatively heavy and not very fresh sludge did not give satisfactory results. The quick-opening door could not stand the pressure. Another trial will be given as soon as the door can be replaced.

Experiments With Centrifuges

Mohlman reported experiments with two small centrifuges, one of the low-speed basket type and the other of the high-speed bottle type. The basket of the low-speed machine was 8 ins. in diameter and 6 ins. deep. The periphery was perforated with numerous holes 1/16 inch in diameter. When the holes were covered with a strip of muslin cloth, approximately 1 gallon 98 per cent. moisture sludge was put into the centrifuge and after 15 minutes, 700 grams of 91 per cent. moisture sludge were obtained. The high-speed bottle-type machine reduced the moisture from 98 per cent. to 92 per cent. in three minutes. Mohlman stated that in order to be economical there should be an automatic arrangement for removing the cake.

At Cleveland, Pratt and Gascoigne used a laundry centrifuge with a 26-in. basket, lined with a ¼ in. wire mesh inside of which was a canvas bag. In the best run, when the basket revolved about 1,200 revolutions per minute, 60 gal. of 97½ per cent. moisture sludge was added in about 25 minutes and in 2 hours the moisture content was reduced to 84 per cent. The time required would seem to make this process impracticable.

Working on the assumption that the principle used in drying of china clays or that used in the cream separator might be applicable, a modified basket-type centrifuge and a modified cream separator were tried. The holes of an 8-in. basket-type centrifuge were covered with a strip of rubber packing. The best results were obtained with 1,500 revolutions per minute, which was the limiting speed of the machine. This would seem to indicate that the process would give efficient results if carried on at an increased speed.

but would yield an effluent that must be returned with the sewage to the aeration chamber. A series of tests was made with a cream separator, the bowl of which was modified, by removing the inner disks and discharging the clarified liquid about an inch from the centre of the bowl at the top. The sludge added at the top dropped to the bottom of the bowl, and the liquid was thrown out over the rim. Sludge cakes containing from 85 to 86 per cent. of moisture were obtained by the cream separator in 6 to 8 minutes, which encouraged us to obtain a special machine for further experiments.

Process Appears Practicable

A specially designed centrifuge was purchased from the Tolhurst Machine Works, of Troy, N. Y. This machine is 12 ins. in diameter, 9½ ins. high, and at a speed of 1,800 exerts a centrifugal force of 550 lbs. According to its concentration from 10 to 25 gal. of the sludge are added and 10 lbs. of cake obtained. The sludge cake contains about 88 per cent. moisture. The space underneath the rim contains 0.158 cu. ft. Owing to the small size of the machine and to the fact that the material must be scraped out, the time of cleaning is longer than would be required for a larger machine with an opening in the bottom, so that a large machine could undoubtedly have been filled and emptied more rapidly than the small laboratory machine. It was found entirely possible to fill and empty the small machine four times in one hour. Calculating that the same rate could be used with a 40-inch machine having 46 times the capacity, it was possible to obtain in each filling 460 lbs. of sludge of 88 per cent. moisture, equivalent to 55 lbs. of dry material. One 40-inch machine would, therefore, deliver the equivalent of 2,200 lbs. of dry material in a working day of 10 hours. On the supposition that ½ ton of dry material will be obtained from 1,000,000 gals. of sewage, one machine would dewater the sludge from 2,000,000 gals. of sewage per day. The cost of the 40-inch machine at present is only $750 and the power to run it is small enough to make the process appear practical for preparing sludge cake for a dryer.

The actual cost of dewatering will depend upon the amount of water that can be removed by the centrifuge, the size of dryer and the amount of coal required for removing the residual water. A drying test using 220 lbs. of 88 per cent. sludge cake made by the John P. Devine Company indicates that the dewatering process can be made practical.

Why Cities Should Share in Road Cost

By W. A. McLean*

SUBURBAN roads and assessment of cities for main road improvement are features of Ontario legislation, and as they are new to most parts of the province, the reasons for such requirements are of interest.

The development of main highways has, in every county, required the co-operation of cities. This has been true in countries of Europe, such as England, France, and Belgium. In the United States the city of Detroit is paying 85 per cent. of the cost of roads in Wayne County. Cleveland is paying $800,000 annually for road construction outside of the city. In New York the cities are paying 85 per cent. of the state expenditure. In Massachusetts cities pay 82 per cent. Similar conditions exist in other states.

Cities Separate from Townships and Counties

In the case of cities in the United States, they are, as a rule, not separated from township and county organization, so that a considerable part of their expenditure on main roads is automatically arranged. In Ontario, however, with cities separated from township and county organization, it has been necessary to devise the system of suburban road contributions provided for in the Ontario Highways Act, in order that the existing municipal organization might not be disarranged.

Roads should be built and maintained in proportion to the traffic over them. Roads within two or three miles of a city may cost two or three times the ordinary expenditure of the county on roads, and this extra cost is difficult for the county to finance without co-operation from the city.

The object of a city's contribution would not be to relieve the county of the expenditure which they are now making, or which they may equitably be called upon to make, but rather to improve the standard of roads radiating from the city, and to permit them to be maintained in a condition suited to the traffic over them. Traffic accumulates to a considerable density on the main roads immediately adjacent to the city, and it becomes an unfair charge upon rural districts to construct and maintain roads suited to such accumulated traffic.

Better Roads Possible

Thus the county with provincial aid may be spending for ordinary roads $5,000 per mile, made up of $3,000 from the county and $2,000 from the province. By calling upon the city to contribute equally with the county the two provide $6,000, which entitles them to a provincial subsidy of $4,000. In this way roads costing $10,000 (or $20,000) per mile become possible, to the very great advantage of the cities.

Municipal boundary lines are purely arbitrary and accidental. It cannot be maintained that the true interests and obligations of cities do not extend beyond their boundaries. That city councils are inclined to think of their interests as terminating with the city boundaries is purely a traditional attitude of mind, and in considering the advantages of good main roads, is without basis of fact. Good main roads are a means of rural development, and are a source of local trade, as well as a convenience to city residents. The construction of main highways radiating from a city is so clearly of advantage to the city that artificial boundary lines must necessarily be disregarded in providing equitably for the cost.

Should Province Pay for Roads in Cities?

It has been suggested that the province should contribute to the cost of continuing main roads through a city. But wealth is concentrated in cities. Cities in Ontario have an assessment of $1,033,117,544, and a population of 1,019,627; whereas townships have an assessment of $687,372,853 and a population of 1,027,-

* Deputy Minister of Highways, Ontario, in Annual Report.

220. With the comparatively small amount which cities are asked to pay to the construction of main roads radiating from them it is believed that ample consideration is given to the construction of connecting links within the city, at the cost of the city.

A farm bears a somewhat similar relation to a public highway that the streets of a city bear to the system of county roads. The farmer is aided to build roads to the boundary of his farm, but not to construct lanes and driveways on his farm. If a farm of 100 acres, with a family residing on it, and distant two miles from a county road, is taxed for the construction of such a main road, it is only fair that a city comprising an area of 3,000 acres and containing a population of 25,000, with a valuation equal to 6,000 farms, should contribute to the cost of main roads radiating from it.

The building of expensive pavements within a city does not absolve the city from its obligations with respect to main roads in the open country. City pavements are not designed for traffic requirements only, but are expensive largely because of the advantages of curbing and good boulevards to adjacent property, the cost being reflected in increased property values. Comparing a $4,000 per mile road in the country with a city pavement costing $60,000 per mile, under ordinary conditions of land occupation in Ontario, with four farms per mile on each side of the road, the cost, if levied on a frontage basis, would be twice as great to the farmer as to the owner of a 40-foot city lot.

A Matter of Self-Interest

As a matter of self-interest, due to the benefits which good roads bring to a city, it is clearly a matter in which the cities of the province should heartily co-operate with the province. There is no industry which cities can bonus with so much advantage to themselves as farming. Good roads increase the produce, the saleable produce, from the farms, all of which adds to the prosperity and advantage of the city.

Under the systems of taxation in vogue in the States a much larger proportion of the cost of main highways is met by the cities than is being considered in Ontario. The maximum rate to be levied upon a city for these main arteries is restricted to one-half mill, and the county roads to be designated as "suburban" under the Act would necessarily be restricted to such mileage as could be adequately improved with the expenditure becoming available through the combined contributions of the city, county, and province.

Mileage of Radiating Roads

The mileage of radiating roads to which each city should contribute will depend somewhat on local conditions. Consideration may be given to the local trade traffic entering the city, or to points of local interest close to the city, or to an area approximately that required to supply the city with local farm produce. It is estimated that one square mile, as commonly farmed in the Province of Ontario, will support a population of about 300 persons, from which the radius of the supporting area may be estimated. Broadly, it would appear feasible to require the smaller cities to give proportionate support to about six miles of road for each mile of radius of supporting area, or, on another basis, two miles to each million of assessment.

The Ontario Highways Act came into effect in January, 1916, and there is some negotiation to be carried out in order to effect organization in all cases.

The counties in which suburban roads have been settled are: York, in which Toronto contributes to the entire county road system, with a special grant of $250,000 to the Toronto-Hamilton highway; Frontenac, in which Kingston contributes to approximately 60 miles of road; Waterloo, in which Galt contributes to 25 miles and Kitchener to 12 miles; Essex, in which Walkerville has contributed to about 8 miles, and Windsor, with which negotiations are now in progress. Hamilton has contributed $50,000 to the Toronto-Hamilton Highway, and negotiations are in progress with the county with respect to other suburban roads.

Fireproof Shingles Wanted

A field for investigation of tremendous importance to the industries affected lies in an attempt to discover a satisfactory treatment for wood shingles that will render them measurably fire-retardent. No process can ever make wood "fireproof," for no class of material will resist fire under all conditions. Innumerable experiments have been made to demonstrate the efficacy of various compounds, but conclusions of practical value have never been reached. While tests have proved certain treatments to be suitable for one particular condition, such as retarding fire, the substances used have failed to embody equally valuable qualities of permanence and weather resistance. A good shingle fire-retardent must also have endurance, insolubility, attractiveness and cheapness.

With the discovery of a satisfactory method of treatment, there does not appear to be any sufficient reason why shingles should not become a most desirable roof covering for dwellings and other buildings outside congested areas. They have adaptability and beauty superior to most roofings, and entail the least first cost. Since the temporary nature of many of our buildings, the migratory tendencies of our people and the rapid development of our cities and towns are factors making the use of wooden construction advisable, to attempt to legislate the shingle or the frame dwelling out of existence is both uneconomical and impracticable in Canada at the present time.—Conservation.

Tenders Wanted for $10,000,000 Flood Prevention Project

Tenders will be received by the directors of the Miami Conservancy District, Dayton, for a number of contracts which are a part of the system of flood control in this district. The work which is to be proceeded with at present comprises five contracts for dams and seven contracts for river improvements. These involve excavation, embankment, concrete work, riprapping, in very large quantities. The Contract Record has received a publication listing the estimated quantities of the various items on the contracts and containing information for bidders.

The Kerr Engine Company Have Leased Part of Plant

The Kerr Engine Company, Limited, of Walkerville, Ont., the valve manufacturers, have leased the iron foundry department of their plant to the Standard Foundry & Supply Company, who will hereafter supply the Kerr firm with all their grey iron castings in connection with their valve and hydrant business. The Standard Foundry Company, in addition to supplying the Kerr Engine Company with their castings, will engage extensively in general jobbing work.

Principles of Quantity Surveying

General Methods to be Followed in Taking Off Items and Preparing a Bill of Quantities—Typical Detailed Analyses

QUANTITY surveying is being adopted to a greater and greater extent on this continent in connection with large projects. The most widespread application of this system, however, occurs in England, where it was originated. The following article, summarized from a lecture by C. O. Mourant before the Junior Institute of Engineers, describes a method used in the preparation of bills of quantities, known as the London method:

The preparation of a "bill of quantities" is necessary before giving an estimate. This "bill of quantities" is prepared by a properly qualified "quantity surveyor" in the case of large constructional engineering or building work. Where quantities are not supplied, the estimator must thoroughly examine the drawings and specifications supplied by the architect, and then proceed with the quantities.

Three Operations

The preparation of quantities consist of three operations, viz.:

1. Taking off, or measuring the items of labor and materials for the work from specifications and to drawings. The measurements obtained are then entered on specially-ruled paper, the first column being for the "timesing" of an item, the second for the dimension, the third for cube or square of the dimensions, the fourth for the description of the item measured, and the fifth for waste and rough notes.

2. The second operation consists of collecting all items of the same nature and description together and making a total of the measurements, and is known as "abstracting."

3. The third operation consists of arranging the items in the form of a bill in such order as will be described later.

The last two operations are known as "working up," as distinct from "taking off."

"Taking off" requires expert knowledge of constructional details, and is done by experienced men, whilst "working up" can be entrusted to juniors, if carefully checked.

Methods of "Taking Off"

"Measurers" vary in their methods of taking off. Some adopt a method which is now almost obsolete—i.e., taking off the quantities by the trades. Others divide the work into carcase and finishings, the principal disadvantages here being the covering of the same ground twice to discover and measure the finishings. This invariably leads to certain articles being overlooked. Another method, which amounts to a combination of the two preceding ones, consists of measuring the items as they come and disregarding the trades, carcasing, and finishing. This arrangement enables one to measure the whole of the finishing of a door opening at the same time as the deduction is made in the brick wall for such openings. Before considering a detailed system of "taking off" it may be well to record some very important points connected therewith:

Items to be very carefully described so as to leave no doubt as to meaning, and description to be as complete as possible, and the method of measurement correct.

Taking Dimensions

In taking dimensions one particular rule should always be observed, viz.: When measuring superficial areas, the length of the item should be first put down, then the width or height. In measuring cube dimensions, commence with the length, then the width, and then the height or thickness. This arrangement is most important. Certain fundamental principles in booking items and methods of taking off must be observed. Always work in clockwise direction—commencing from top left-hand corner to right-hand corner, and measuring from left to right and north to south.

Filling and Ramming.—Full description of method adopted necessary.

Measure filling in super. yards if less than 12 in. thick.

Measure filling in cubic yards if more than 12 in. thick.

Measure bed of hardcore in super. yards if less than 12 in. thick.

Planking and Strutting.—Measure per foot run, giving depth; number strutting and planking to pier holes.

Concrete in Cubic Yards

Concretor.—Measure concrete in footings to walls in cubic yards. Allow for temporary rough boarding to sides of footings.

Measure surface concrete if less than 12 in. thick in super. yards. If more than 12 in. thick, measure in cubic yards. Allow as above for rough boarding.

Drains.—Measure in lineal feet, giving size and full description of pipes; state method of jointing, average depth of excavations, if drains are to be laid on or embedded in concrete bed, and nature of composition of concrete. Bands, junctions, and diminishing pipes should be numbered and described as "extra only" on 4 in., 6 in., or 9 in. pipes. Number connections to soil pipes, sewers, etc.

Brickwork.—Measure brickwork by superficial rod (272¼ ft. by 1½ bricks thick). This is London method. In the provinces brickwork is measured in super. yards, and reduced to one brick thick.

Measure footings to walls by average thickness between top and bottom courses. Always be careful to finish measurements at some particular line on plan or elevation, so that no difficulty is encountered in following dimensions should surveyor have to leave work suddenly.

Deductions in Brickwork

Brickwork in cement described as "extra only." Brickwork in raising to old walls or filling in should be kept separate. Deduction of brickwork: Take this for doors or window openings for outer thickness up to face of frame, for inner thickness to outside of frame. Measure hollow brick walls and walls less than one brick in feet super., owing to extra labors in facing both sides.

Measure thickening to old walls per foot super. Measure dampcourse per foot super. Measure vertical dampcourses per yard super. Measure cutting, tooth-ing, and bonding per foot run. Measure flue pipes per foot run. Give particulars of materials to be used, thickness, etc., in each case.

Coppers, chimney-pots, etc., should be numbered.

Pavior.—Measure per yard super. In brick paving laid herring-bone, allow 3 in. by girth of room as allowance for waste.

Underpinning.—Measure individual items for this as previously described.

Mason's Work.—Measure the net size of the block of stone out of which work can be cut. Measure stones less than 3 in. thick per foot super. Measure other hard stone dressings per foot super., and give full description of labor involved.

Slate and Tile Quantities

Slater.—Measure per square of 100 ft. super. Slates are described as duchess, countess, ladies', smalls, queen's, etc. Allow for cuttings to hips and valleys 6 in. on each side. Measure special ridge rolls per foot run.

Tiler.—Measure roofing tiles and vertical weather tiling per square of 100 ft. super. Give length of lap, description of tiles, etc. Measure floors in super. yards, giving thickness. Measure beams and footings to columns in yards cube.

Carpenter.—Measure shuttering and centering for reinforced concrete floor slabs per yard super. State height of floors. Measure shuttering and centering to beam sides and soffits per foot super. Measure shuttering and centering to sides of columns per foot super. Keep special shuttering separate.

Structural Carpenter's Work.—Measure as per foot cube. Size of members is large, and amount of labor is therefore small.

Joiner's Work.—Measure wood blocks per yard super. Measure skirting, chair rails, framing, etc., per lineal foot. Measure doors, windows, etc., as per super. foot. Quantities for plumber, zinc worker, hot water fitter, plasterer, painter, etc., are dealt with on similar lines—i.e., large surfaces are measured as per foot or per yard super. Plumbing work is generally weighed in hundredweights, quarters, pounds, etc., but some items are measured per lineal foot. Measure items which entail much labor as numbers.

Making Out Bills

Putting Quantities Into Bill Form.—First abstract quantities and ascertain capability of abstractor by the order in which the various items are put on the abstract sheet. These items should be so arranged that they can be copied direct on to the bill paper without any rearrangement. Generally speaking, cubic dimensions come first, then super., then running dimensions, then numbered items. Having put items into bill form, the estimator prices same.

Bill of preliminaries and provisions to be prepared to include for depositing plans with district or municipal surveyor; fees, etc., to be paid; providing and fixing hoarding around site where necessary; making temporary road; laying on water and paying company's charges for building operations—all have to be considered; insurance against fire and workmen's compensation.

The contractor or estimator should visit site of works; examine ground for pricing excavations; find out nearest sand and ballast pits, and quality of same; determine best means of getting plant and machinery to job, and find out if necessary to bring everything from main depot, or whether it would be cheaper to hire same locally or buy new.

Typical Examples

Proceed then to analyze the prices as below. Dealing with excavator, Item 1: Remove top soil to depth of 6 in. and cast away. A builder's cart is 6 ft. by 3¼ ft. by 2½ ft deep, and holds 45 cubic feet of material, equals 1 2/3 yards cube.

Earth wagon holds 3 cubic yards.

Wheelbarrow holds 50 bricks, or 1/10 yard.

Earth, when dug, increases about 25 per cent.—that is to say, 1 cubic yard of earth in natural state equals 1¼ cubic yard (about) when dug.

Chalk and rock increase about 40 to 50 per cent.

Number of Excavators to Shovellers.—One excavator to two shovellers and two removers.

Excavator can dig and throw out per day of 10 hours: In loamy clay, 15 to 16 yd. cube; in made ground, 13 to 15 yd. cube; in common ground, 8 to 10 yd. cube; in stiff clay and gravel, 5 to 7 yd. cube; in hard ground, where picking is required, 3 to 4 yd. cube. For work in trenches deduct 15 to 20 per cent.

Removing soil for a distance of 50 yards and depositing equals 30 yards cube.

Assume rate of pay equals 8½d. per hour, equals 7s. 1d. per day of ten hours.

Therefore, digging ground 10 in. deep equals 4d. per yard super.

Therefore, digging common soil equals 3¾d. per yard super.

Therefore, digging loamy clay in trenches equals 8½d per yard cube.

Add for removing and refixing planking and strutting to sides of excavations 1d. per yard super.

Levelling bottom of trench, ½d. per yard super.

Total price for digging, planking, and levelling equals 10½d., to which must be added profit and working expenses.

Other items of excavator's work must be analyzed in the same manner, care being taken to include for all the various items of labor in connection with any particular piece of work. For throwing earth a height of 6 feet, or part of same, allow price equal to 25 cubic yards per day of ten hours, or about 3½d. per yard cube extra to above.

Planking and strutting to sides of excavations, allowance to be made for use and waste of timber. Timber planks and struts can be used five or six times before being scrapped. Therefore, to cost of labor add one-sixth price of timber.

Analysis of Prices for a Coffer Dam for Pier of New Bridge

Assume a size, say, 30 ft. by 10 ft. by 10 ft. depth of water.

King piles, 12 in. by 12 in., should be driven from barge upon which to erect temporary staging for further permanent pile-driving.

The cost of this staging must be added to tender for work. For coffer dam drive two 12 in. by 12 in. piles at each corner of pier and at 10 ft. apart along sides. Bolt 11 in. by 6 in. waling pieces to top of piles. Then two layers of 12 in. by 6 in. sheet piles with 12 in. space between for puddle clay; say piles driven 10 ft. into ground.

Quantities are, therefore:

	£	s.	d.
16 No. 12 in. by 12 in. piles 22 ft. long = 352 cubic feet at 2s.	35	4	0

		£	s.	d.
80 ft. 11 in. by 6 in. and 80 ft. 9 in. by 3 in. = 51 cubic feet at 2s.	=	5	2	0
74 No. 12 in. by 6 in. piles 22 ft. long = 814 cubic feet at 2s.	=	81	8	0
		£121	14	0

		£	s.	d.
Allow quarter of above for use and waste	=	30	8	6
Driving 160 lineal ft. 12 in. by 12 in. piles at 10d. per lineal ft.	=	6	13	4
Driving 740 lineal ft. 12 in. by 6 in. piles at 6d. per lineal ft.	=	18	10	0
Handling and fixing walings 6d. per ft. cube	=	0	13	0
16 No. shoes for 12 in. by 12 in. piles and fix 3s. 6d.	=	2	16	0
74 No. shoes for 12 in. by 6 in. piles and fix 3s.	=	11	2	0
Pitching piles and moving engine and frame	=	5	10	0
Bolts and nuts, say, 40 No., at 9d.	=	1	10	0
Puddle clay = 30 cubic yards at 9s. cubic yard	=	13	10	0
Ramming clay	=	1	10	0
Cost of pumping water from inside coffer dam, including engine, pump man, etc.	=	5	0	0
Net cost		£97	2	10

Add profit and working expenses.

When tendering for work in connection with water, allow for good prices to pay for unforeseen contingencies, as otherwise great loss may be experienced on the contract.

Analysis of Concretor's Work

Voids in aggregate = 30 per cent. or 40 per cent.

Contraction due to mixing = 10 per cent. or 12 per cent.

Therefore, 1 yard concrete:

		s.	d.
1 1/5 yards ballast at 6s. per yard	=	7	2½
4 bushels of cement at 30s. per ton	=	5	6
2½ hours laborer at 8d. per hour	=	1	8
		14	4½

Add profit, etc.

Extra must be allowed for work in small pieces and in awkward positions.

Concrete for reinforced concrete work is of very expensive nature, owing to skill necessary for mixing and placing.

Proportion—1 cement, 2 sand, 4 broken stone.

		s.	d.
27 cubic feet broken stone at 8s. 6d. per cubic yard	=	8	6
13½ cubic feet sand at 8s. 6d. per cubic yard	=	4	3
450 pounds cement at 30s. per ton	=	6	0
		18	9
		s.	d.
		Per yd. cube.	
This will equal 31 cu. ft. of finished concrete	=	16	4
Labor, mixing, and placing = 12 hrs. at 8½d. per hour	=	8	6
		24	10

Add for hoisting over 20 ft., 1s. 3d. per yd. cube.

Add profit and expenses.

Cost of labor for concrete in beams, about 1s. yd. cube more, and in very thick slabs about 2s. yd. cube less than above.

Above prices do not include for fixing or placing steel bars, etc.

Any special work should be carefully considered and priced accordingly, first of all analyzing the item and determining exact quantities.

Carpenter's Work

A load of timber equals 50 cubic feet.
A St. Petersburg standard equals 165 cubic feet.
A stack equals 108 cubic feet.
A square equals 100 super feet, equal 10 ft. by 10 ft.
100 deals equals 120 number.

Cost of fir in floor joists plates and girders:

	s.	d.
1 cub. ft. fir at £15 standard	1	10
Carpenter, ¾ hour at 1s.	0	9
Nails, etc.	0	1
	2	8

Add profit, etc.

Fir in roof principals, rafters, purlins, etc.:

	s.	d.
1 cubic ft. fir at £18 standard	2	3
Framing and fixing—1¼ hours, carpenter	1	3
Nails, etc.	0	1
	3	7

Add profit, etc.

	s.	d.
1¼ in. yellow deal batten flooring, per square	30	0
1½ in pitch pine floor, per square	56	0
1½ in. pitch pine wood block floor, per square	6	0

Other trades, such as plasterer, plumber, painter, etc., must be dealt with on similar lines and items carefully analyzed.

Proportion of Cost of Labor and Materials for Different Trades

	Per cent.	Per cent.
Excavator	90	10
Concretor	17	83
Drainlayer	33	67
Bricklayer	30	70
Mason	50	50
Carpenter	30	70
Plumber	25	75
Plasterer	60	40
Smith and founder	30	70

From the foregoing brief notes it will be seen that each item for any piece of work can be properly priced if only it is thoroughly analyzed and the labor involved in the work, together with the necessary materials, is considered and carefully noted, and a fair value can then be given to each part.

The author was careful to point out that the above prices were given for example only, as all the prices are now greatly increased owing to the rise in wages and materials, but whatever the rates of wages or price of raw materials the analysis of the items remains the same.

For, after all, estimating for structural and building work is only more advanced quantity surveying, because a good estimator must be an expert quantity-taker.

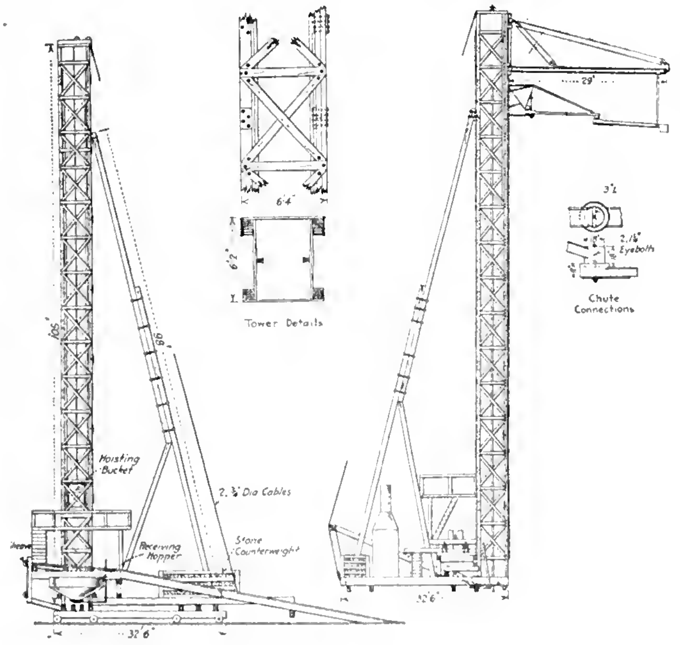
It is understood that the firm of MacKinnon, Holmes & Co., Ltd., have recently received from the Imperial authorities a large order for marine work, which will keep their plant in operation for many months to come.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Welland Canal Lock Walls Concreted with Movable Counterweighted Towers

In concreting the lock walls of the Welland Ship Canal, special movable hoisting towers were used. The concrete was hauled from the mixing plant to the tower in six-yard dump cars drawn singly by dinkey locomotives. Each travelling tower was 105 ft. high mounted on one corner of a platform 32½ ft. square, built up of 8 x 16 timbers and supported by 16 wheels on two standard gauge tracks. On the diagonally opposite corner the hoisting engine was located and on the other two corners, stone boxes 5½ ft. wide by 12 and 14 ft. long were furnished to contain counterweights to increase the stability of the towers. The steam boiler was placed adjacent to one of these boxes. Cantilever beams 32½ ft. long with an overhang of 14 ft. 3 ins., supported an inclined receiving platform with



Tower is mounted on counterweighted platform on two tracks. A trailing connecting track enables cars from mixer to reach receiving hopper.

tracks that trailed behind the tower. On this platform the dump cars filled with concrete were hauled.

The tower was built in 16 storeys, 7½ ft. high. Each of four corner posts was made with pairs of 4 x 8 in. verticals 14 ft. long, breaking joints and braced with 2 x 6 in. horizontal and diagonal struts secured by one ½ in. bolt through each end. An 8 in. I-beam, 35 ft. long, reinforced two vertical posts on the side adjacent to the chute at the upper end. The top of the tower was guyed by two ¾ in. cables anchored to the edge of the platform and was also braced with a 12 x 12 in. leg reaching from near the top of the tower to the platform.

A short section of inclined track, movable with the tower, was connected at the upper end to the dumping platform 10 ft. above the bottom of the tower and at the lower end engaged the rails of one of the tracks on which the tower moved. The bottom-dump concrete cars were hauled over to the top of the dumping platform and there discharged to a large receiving hopper under the floor. The hoisting bucket dumped into a receiving hopper and the concrete was discharged through a flexible jointed chute supported by a 29-ft. tower boom.

Hoisting Engine Will Pull Sheet Piles If Not Driven Too Hard

When sheet piles are not driven too deep, as is frequently the case in trench work, they may be conveniently pulled without a derrick or traveller, with a line operated by a hoisting engine and led straight from it to the pile. A piece of timber from 10 to 20 ft. long is laid under the line parallel with it and a secure heel bearing is provided for the timber at the end nearest the hoisting engine. The other end is blocked up a few feet from the surface of the ground and the line secured to it.

Operating the hoisting engine causes the timber to revolve around the heel, swinging the line to a steeper angle and producing a pull that will start the pile and pull it out if not driven too deep or too hard. In this way several piles on both sides of the trench can be pulled with the hoisting engine in one position, after which it can easily be skidded to the middle of the next group of piles and so on with very little trouble.—Contracting.

Wooden Strip Avoids Joint Trouble in Concrete Roads

In a recent issue of the Engineering News-Record, S. E. Fitch, senior assistant engineer New York State Highway Department, urges that many of the troubles attending the use of transverse joints in concrete pavements can be avoided by installing at the bottom of the slab a ⅜-in. wooden strip of about half the depth of the concrete. In this manner planes of weakness where transverse cracking may concentrate are definitely located.

Four joints of this type were installed under the writer's direction in 1915, and withstood the following winter without cracking, although fine hair cracks appeared in June, 1916. These cracks were very narrow, and followed a zigzag line around the individual stones of the concrete, directly over the wooden strip. The zigzag cracks nowhere departed more than two inches from a straight line. These cracks were exposed to traffic all summer, and no spalling of any kind has been noticed.

The result was so satisfactory that in 1916 the writer installed ten consecutive joints of the same type on each of two roads. These have gone through one winter and are now in excellent shape. Fine hair cracks have appeared over most of the joints, but the fact that the pavement has not yet cracked over a few indicates that the slabs might have been made somewhat longer than 30 ft. in this particular locality. In no case has the pavement cracked, except over the wooden strips.

Several Advantages Are Secured

The advantages obtained by this method over other types of joints are: (1) No spalling along the joints; (2) no interference with screeding or floating, and a much smoother pavement; (3) the joints are cheaper and easier to install, the wood may be of cheap material and need not be creosoted; (4) better appearance of the road.

The advantages of this method over no joints at all are that by choosing the proper length of slab to correspond to the width of pavement and to climatic conditions the cracks will be minimized and will run square across the pavement at regular intervals, instead of occurring haphazard and running in every direction.

It is absolutely necessary that the top of the joint be kept below the surface of the slab a sufficient distance to give body enough to the concrete over it to prevent spalling. This minimum depth has not yet been definitely determined, but from observations already made a distance of 2½ in. near the edges and 3½ in. near the center of pavement seems to work out very well. Should this distance be much greater, it probably would necessitate decreasing the length of the slab, in order to insure the cracking at the joints only.

A simple way to prevent the rising of the wooden joints up through the concrete is to drive short pegs at intervals of about 7 ft. across the road and nail through the strip into the pegs. Bent wires hooked over the joint would answer the same purpose. The strips should be installed by means of a taper installing board in the usual manner.

While no spalling has occurred on any of the joints mentioned, it is realized that "one swallow does not make a summer, and it may prove to be advisable to treat these cracks with a small amount of bituminous material as soon as they appear, especially on roads of heavy traffic. So far as these experiments go, the writer believes that the resulting fine cracks are as satisfactory joints as he has yet seen.

School Fire Escapes a Source of Amusement

Some of the California schools are equipped with novel fire-escapes, which are not only a safeguard, but afford the children as much amusement as a regular playground equipment. One of these fire-escapes in Tropico, near Los Angeles, consists of several long sheet metal chutes, reinforced with angle iron and secured to the walls of the building. They extend from an iron platform on the second floor, which leads from the main corridor., Separate chutes are provided for the boys and girls.

The teachers encourage the use of the slides as an amusement to accustom the children to them. Each slide ends in a slight upward curve to check the momentum of the descent. At the point where the children reach the ground a pile of loose sand breaks the fall.

In Venice, Cal., a spiral chute is employed, which is enclosed in a cylindrical metal casing. This is entered from a platform leading from the upper storey. Like the straight slide, it is used as an amusement device by the pupils. A local hospital makes use of one of the same design.

Canadian Water Powers Described Before A.I.E.E., Toronto Branch

The first regular meeting of the Toronto section of the American Institute of Electrical Engineers was held on Friday evening, Sept. 21, in the Engineers' Club. The entertainment was of a quite novel character, being a representation by motion pictures of various water-power developments and electrical distribution systems in the Province of Ontario, principally those controlled by the Hydro-Electric Power Commission of Ontario. The pictures also showed industrial scenes in many of the more prominent Ontario cities, including London, Windsor, Galt, Hamilton, Toronto, Collingwood, Owen Sound, and others. In introducing the picture display, Mr. W. G. Gordon, the chairman of the section, spoke on the importance of water-power development briefly, as follows:

Water-Powers of Canada

One of the most important results of the great war in Europe has been to accentuate the need for economy in every walk in life. This is just as true in engineerng as in any other field, and every natural resource must be conserved to make up for the wastage of war. This is particularly the case with the world's fuel supply. Coal and oil resources are gradually tending towards exhaustion, and it has become a duty on the part of the engineer to substitute other sources of power. Water-power, as present in the great rivers and reservoirs of our Dominion, is inexhaustible; and, while its development frequently demands a large outlay per kilowatt produced, such outlay has the great advantage of helping to conserve the coal and oil supply for the use of the allied navies and for those industries in which the use of such fuel is vital.

One ton of good coal (12,000 heat units per pound) is equivalent to 7,000 kw. hours. In a modern power station, however, utilizing about 16 per cent. of these heat units, a ton of coal yields only 1,100 kw. hours, so that one kw. year is the equivalent of eight tons of coal. It is, therefore, false economy to hold over the development of water-powers till after the war, as any work which will help to conserve our fuel supply is not only desirable but necessary. One of the greatest handicaps which Germany has to face at the present time is her lack of good water-powers, her engineers being forced to use fuel-generated power for their electro-chemical industries.

Among the war industries in which hydro-electric power is an essential factor are the production of nitrogen compounds and cyanamide, aluminum and magnesium, calcium carbide, steel, and copper. All of these are now being produced in Canada, and such processes as these are particularly advantageous for a hydro-electric system on account of the high load factor, as the basis of cheap power is to secure the highest possible ratio of average to maximum load.

The well-being of future generations is linked up with the problem of nitrate production, and fertilizer must be produced to increase the productivity of every acre of land under cultivation. A kw. year of electric energy will produce nearly one ton of fertilizer, and something like 4,000,000 tons per annum is the present consumption of this material.

Probably no country in the world is more fortunate in the exttnt and location of its white coal than is Canada. Practically every commercial centre from coast to coast, except only a few in the middle prairie provinces, have abundance of water-power available, not only for present needs, but for all anticipated requirements. Indeed, the fortunate location of Canada's water-powers is the outstanding feature of her water-power resources. The Conservation Commission's estimate of Canada's water-power, near population centres, is 17,746,000 horse-power, of which only 1,712,000, or about 10 per cent., is developed. The 17,746,000 horse-power is inclusive in the case of Niagara Falls, Fort Frances, and the St. Mary's River at Sault Ste. Marie of only the development permitted by international treaties, and, further, does not contemplate the full possibilities of storage for the improvement of present capacities. The amount developed of 1,712,000 horse-power is inclusive of all water-powers, whether used for the production of electricity, pulp grinding, milling, and other uses.

Ontario leads in this total, with 789,466 horse-power, Quebec being second, with 520,000 horse power. The power produced on the Canadian side of Niagara Falls totals about 365,000 horse-power.

Were we able to work at 100 per cent. load factor, the total energy in water-power already developed in Canada would represent an equivalent of over 100,000,000 tons of coal per year.

Mainly Constructional

East and West—From Coast to Coast

The Car-Bex Brick Company, Limited, has been incorporated at London, Ont., and propose to deal in building materials of all kinds.

The work on the London road pavement at Sarnia, Ont., is now nearly completed. The pavement is of concrete 7½ inches thick, reinforced with woven wire.

The city council of Toronto recently authorized the hypothecation of $4,000,000 worth of bonds to raise funds to the amount of about $2,000,000 for harbour work.

The value of building permits issued in Winnipeg for the month of August is $116,100, as against $163,450 for the same month last year. For the first eight months of the year the total is $1,983,000, as compared with $1,963,450 during the corresponding period in 1916.

The British Admiralty has recommended the construction of drydocks at Esquimalt, B.C., and Halifax, N.S., and the British Treasury Department has given favorable consideration to the matter, according to the statement of Hon. Robert Rogers in the House of Commons recently.

Etobicoke Township Council will be asked to ratify a scheme to reduce the proposed width of the Toronto-Hamilton highway between the Humber River and the eastern boundary of Mimico, from 66 feet to 56 feet, and thus effect a saving of $48,000 to the ratepayers. The proposal was made by Mr. Geo. H. Gooderham, of the Highway Commission.

A deputation representing the town of Fort Qu'Appelle and adjacent rural municipalities waited on officials of the Saskatchewan government recently with respect to the location of a new bridge over the river joining Echo and Katepwe lakes, at Fort Qu'Appelle. They were informed that the structure would probably be erected next spring. It will be of reinforced concrete and is to be located about two blocks east of the site of the present bridge.

Representatives from Fergus, Arthur, Mount Forest, Holstein, Guelph, Durham and Hanover, recently met at Owen Sound, Ont., with members of the local Board of Trade and municipal council, to discuss the formation of an association to further the scheme for a Hamilton-Guelph-Mount Forest-Durham-Owen Sound branch of the proposed provincial highway. It was decided to hold a convention at Guelph on October 15, at which representatives from all municipalities from Hamilton to Owen Sound inclusive are to be present.

Work is progressing on the concrete vessel which the Atlas Construction Company has undertaken to build for a Montreal syndicate. The steel reinforcing ribs are placed 27 inches apart and are 5 inches wide at the top and 14 inches at the bottom. The form work is to be built up around the ribs, after which the concrete will be poured, allowing for a shell four to five inches thick. The ship will be 126 ft. 10 ins. long, 22 ft. 6 ins. moulded breadth, and 12 ft. 6 ins. moulded depth. It will be a single screw ship, capable of making from 8 to 10 knots and will be used on the lakes at first and on the ocean perhaps later. There will be five keels running the full length of the ship, 29 inches deep.

The work of the Toronto Harbor Commission for this year and next year is being confined solely to revenue-producing land in Ashbridge's Bay industrial area and the inner water front. Of the 257 acres that have been reclaimed in Ashbridge's Bay, 160 acres are now under lease, the land being valued at from $2,000 to $3,000 an acre. Next year the commission intend to reclaim about 150 additional acres, so that an asset worth at least $3,000,000 will be produced by a portion of the $2,000,000 proposed to be expended. It has been decided that the work on the boulevard will not be prosecuted next year. Work has been proceeding on the ship canal, and when the walls are completed filling operations adjacent to it may be carried on.

Cement walks recently laid in St. Catharines, Ont., have proved defective, and Mr. F. B. Rutherford was retained by the town to make an examination and trace the source of the trouble. A report was recently submitted by Mr. Rutherford. He had some of the cement examined and tested at the provincial laboratories and stated that the cement shows practically no strength in the several tests carried out. Having found the sand and gravel used in the concrete the best obtainable in the district, and the workmanship good, he gave it as his opinion that the cause of the failure of the work was entirely due to the cement. The engineer does not think there is any use trying to save the work done; the town will simply have to use the walks as long as they may last and then rebuild them entirely.

Personal

Mr. R. C. Manning has been appointed assistant to Mr. W. D. Robb, vice-president of the Grand Trunk Railway, in charge of motive power, car equipment and machinery.

Obituary

Lieut. William Douglas Scott, a student member of the Canadian Society of Civil Engineers, has been killed in action. He was the only son of Mr. G. R. Scott, late Fellow of Merton College, Oxford, and graduated at McGill University, where he took his B.Sc. degree. He was for some time engaged in survey work in the Rocky Mountains for the Canadian Government. Being unable to obtain a Canadian commission, owing to short sight, he returned to England, and received a commission in the Oxford and Bucks Light Infantry. He was wounded in July, 1916, and also in November, but returned to the trenches in May last

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Alberta, Province of.
The Department of Public Works, Provincial Government contemplate the construction of a good roads system, costing $30,000,000. Deputy Minister, L. Charlesworth, Parliament Buildings, Edmonton.

Arnprior, Ont.
Town Council contemplate the construction of tarvia pavement on John St. Clerk, T. H. Grout.

CONTRACTS AWARDED

Dundas, Ont.
The Canadian Engineering & Construction Co., Bank of Hamilton Bldg., Hamilton, have the general contract for relining reservoir for the Utilities Commission, Town Council.

St. Alexis de Grande Baie, Que.
Pierre Laberge, Riviere du Moulin, Chicoutimi, has the general contract for macadam road for the Municipal Council.

Toronto, Ont.
The Godson Contracting Co., Ltd., Manning Chambers, have the general contract for $150,000 extension to Rosedale Creek Sewer for the Board of Control.

Verdun, Que.
M. J. Stack Paving & Contracting Co., Ltd., 167 McCord St., have the general contract and are in the market for cement, sewer pipes and all general equipment in connection with the construction of sewers and sidewalks costing $50,000 for the City Council.

James Millen, 440 St. Patrick Street, has the general contract for reconstruction of intake pipe for the Municipal Council.

Railroads, Bridges and Wharves

Cartierville, Que.
City Council contemplate the erection of a $200,000 bridge over Black River. Engineer, W. Chase Thomson.

Pinkerton, Ont.
The Grand Trunk Railway contemplate the erection of a station to replace one destroyed by fire at a loss of $4,000. Superintendent, Mr. Forrester, London.

St. Clements, Man.
Tenders received at the Municipal Offices, Dominion Bank Building, Selkirk, until noon Oct. 1 for the construction of concrete culverts and fill for the Municipal Council. Secretary-treasurer, Thos. Bunn.

CONTRACTS AWARDED

Fort William, Ont.
The following contracts have been awarded in connection with the erection of a $35,000, three-storey, stone, frame and brick railway station for the Canadian Northern Railway, head office, Toronto:—Steel, Dominion Bridge Co., Canada Bldg., Winnipeg; mill work, Acme Sash & Door Co., 304 Des Meurons Street, St. Boniface; cut stone, Tyndali Quarry Co., Ltd., 1591 Erin St., Winnipeg; painting, Pratt & Lambert, care of general contractor, Geo. McLeod, 497 Raglan Rd., Winipeg, who will carry out the masonry, roofing and plastering.

Hamilton, Ont.
Robt. Campbell, 117 Duke St., has the general contract, masonry, steel, carpentry and roofing for $4,000, one-storey, frame addition to machine shop for Toronto, Hamilton & Buffalo Railway Co., Hunter and James Streets, who will let smaller trades.

Geo. E. Mills, 614 King St. E., has the general contract, masonry, steel, carpentry and roofing for round house stalls costing $8,000, for the Toronto, Hamilton & Buffalo Railway Company, Hunter and James Sts., who will carry out the plumbing, heating, painting and electrical work.

London, Ont.
John Hayman & Sons Co., Ltd., 432 Wellington Street, have the general contract for interior remodelling of car barns costing $5,000, for the London, Port Stanley Railway.

W. Skelly, 242 King St., has the plumbing and heating, and Benson & Wilcox Co., 264 Dundas St., the electrical contract for remodelling station costing $15,000 for the Canadian Pacific Railway, head office, Montreal.

Public Buildings, Churches and Schools

New Westminster. B.C.
Tenders have been called for clearing and grading site on Twenty-seventh St., on which the School Board will erect a school. Address secretary, City Hall.

Ottawa, Ont.
Millson & Burgess, Union Bank Bldg., will call tenders shortly for the erection of a $15,000 church.

Toronto, Ont.
J. H. Walker, 234 Concord Ave., superintendent of construction for the $7,000, one-storey, stucco and brick church for the Seventh Day Advensists will let heating, plumbing and plastering.

Trail, B.C.
The Roman Catholic Church contemplate the erection of a tile and cement church costing $8,000. Priest, Father Teck.

CONTRACTS AWARDED

Emerson, Man.
The following contracts have been awarded in connection with the erectior of court house and municipal buildings, costing $38,000, for the Department of Public Works, Provincial Government, Winnipeg: Steel, Dominion Bridge Company, Ltd., Canada Building, Winnipeg; plumbing and heating, Bowyer-Boag, Ltd., 50 Olivia St., Winnipeg. The general contractors, Gray & Davidson, 621 Wall St., Winnipeg, will carry out the masonry, carpentry, plastering, and painting.

Foxwarren, Man.
The following contracts have been awarded in connection with the erection of a school costing about $50,000 for the Municipality of Birtle:—Mill work, McDiarmid & Clark, Princess and 7th Sts., Brandon; electric wiring, J. Roller, 439 Selkirk Ave., Winnipeg; plumbing and heating, H. A. Manwaring, Birtle. The general contractors, The Progress Construction Co., Ltd., 88 Provencher St., Winnipeg, will carry out the roofing, plastering and painting.

Fredericton, N.B.
Scott & Forbes have the general contract for hospital buildings and alterations to Government House, costing between $80,000 and $100,000, for the Dominion Government.

Halifax, N.S.
Frank Reardon, Argyle St., has the painting contract for St. John's Presbyterian Church, Windsor and Willow Streets.

Montreal, Que.
The Phoenix Bridge & Iron Works, Ltd., 83 Colborne St., has the steel contract for $75,000, one-storey addition to building for the Provincial Government, Quebec. The general contractor, J. B. Gratton, 419 Labrecque St., will carry out the carpentry work.

Ottawa, Ont.
W. J. McGuire, Ltd., 91 Jarvis St., Toronto, have the general contract for plumbing, pipes and fixtures costing $129,900, for the Dominion Parliament Buildings.

Purcells, N.S.
J. P. Burke, 13 Lemarchant St., has the general contract for church for the Anglican Diocese.

St. Louis de Courville, Que.
J. Gosselin, 55 St. George St., Levis, has the general contract and will carry out the masonry and carpentry for church for the Parish.

Sydney, N.S.
Shaw & Mason, Ltd., 204 George St., have the tar and gravel roofing and metal work, and Urban Lewis, 78 Prince St., the heating and plumbing for $53,000 brick school for the School Board.

Business Buildings and Industrial Plants

Halifax N.S.
J. E. Butler, Chebucto Rd., will erect a $4,000, two-storey, frame addition to his store.

Hamilton, Ont.
D. A. Brebner Co., Burlington St. E.,

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Principal Contents

Page

Arranging the Building Site

MUCH is being learned by contractors in these days when the emergencies of war have made speed a factor of prime importance in the construction of such buildings as munition factories and camps. The old methods, so faithfully adhered to in the past, have had to give place to more up-to-date ideas. If precedent had been too closely followed, the rapidity attained in some of the recent construction work would never have been realized. One point, at least, where a revision has become essential is in the delivery and handling of the various building materials. The vastness of the quantities in many cases, and the necessity of avoiding delays in the handling on the job, have compelled the contractors to institute systems for keeping the materials in order. The lessons which such necessity may teach may well be considered by all contractors with profit.

A very hasty glance at typical pieces of construction work will show that the delivery of building material is too often made in a more or less haphazard way. The material is placed on the site in whatever spot comes handy, so that the site becomes a confusing and heterogeneous mass of lumber, brick, sand, and whatever else may be used during the work. A lack of system of this character, though it may apparently save time at the start, invariably leads to delays and expense before the job ends.

Those contractors who have carefully studied all the details of their business realize the convenience as well as the economy of planning very carefully in advance with regard to the delivery of material on the site. No contractor who aims to be successful can start a job to-day without carefully scheduling his material, both as to time and place of delivery. He should lay out his site, designating the exact locations for each size of lumber, for the brick, stone, sand, cement, and so on. In advance of beginning work, consideration should be given to the track or road facilities, proximity of material to the building, and means of handling from one point to the other. Form lumber, for instance, may be placed so that lumber of a stated size may be kept together in such a way as to be handled with the greatest ease and speed. The time spent in piling the lumber properly is much more than made up by the convenience later. The same system can be extended to the whole list of materials, and the saving in space and convenience of handling will more than justify the expenditure of time and labor.

Concrete Structure in Battle Line Withstands Attempts at Demolition

AS indicative of the extraordinary resistance of reinforced concrete to violent impact, the following instance is of unusual interest. The structure concerned is a reinforced concrete reservoir, located in the battle area of France, in territory recently recovered by the French. The reservoir proper is rectangular, measuring 66 ft. long, 33 ft. wide, and 8½ ft. deep, and, before the attempt to demolish it, was supported on 28 columns 12 in. square in cross-section and 43 ft. 2 in. high from foundation level to the under side of the reservoir. The over-all height was 52½ ft. The columns had their footing on a general foundation raft, and were securely braced longitudinally and transversely at two levels intermediate between the foundation and the reservoir. Under the latter was a system of beams of considerable strength. The cover of the reservoir was divided into panels about 4½ ft. square and had intermediate supports in the form of interior columns 6 in. square. The covering slab was 4 in. thick, and the beams or ribs project above this to the same height as the outer parapet, which provided for the retention of a bed of sand to preserve the interior from extremes of temperature.

This reservoir had served for several years as a storage receptacle for the water supply of the town of Roye. After this town fell into the hands of the Germans, early in the war, it provided excellent accommodation as an observation post, owing to its height, accessibility, and the protection afforded by the cover. In spite of the fact that it had been exposed to constant bombardment from the guns of the Allies for nearly 2½ years, it suffered no material injury, although neighboring buildings were destroyed. During the retirement of the Germans some months ago, an attempt was made to destroy the reservoir by blowing up the supporting columns, in the expectancy that the fall through a height of 43 ft. would completely wreck the reservoir. However, it fell to the ground intact, the only observable damage being a few small cracks. Intimate examination proved that the reservoir was in a wonderful state of preservation, and, outside of the cracks mentioned, the only damage consisted of holes cut in the corners, where high explosives had been inserted in an unsuccessful attempt to destroy the walls.

Why Do Contractors Fail?

ARE contractors good business men So asks the Improvement Bulletin, which is the official organ of the Minnesota State Federation of Builders' Exchanges. Their answer is, of course, many of them are. Their success in their chosen field proves that to be a fact, yet the statement has been repeatedly made that contractors' profits are growing more and more uncertain, and that their average credit rating is surprisingly low. Comparatively few fortunes, even moderate ones, have been made in the contracting business.

Why do so many contractors fail? Is it because they do not adopt business methods that are scientifically correct—that stand the acid test of close analysis? Is it because there is too much guesswork in their business—because they do not check their figures sufficiently—because they forget some costly essential when they figure a job? Undoubtedly that is true in many cases. Uncounted contracting firms have become insolvent because of lax methods. They figured by rule-of-thumb, and their bids were made on a hit-or-miss basis. If they erred on the side of an excessively high figure, they did not get the job; there were no receipts to pay overhead expenses and maintain the organization. If, on the other hand, they omitted one or two items in their figures, they "landed" the job at so low a figure that to carry out the terms of the contract meant a loss.

Much expense may be saved and the danger of mistake may be greatly reduced if the quantities of materials are "taken off" on each job, either at the expense of the owner or by an organization of contractors before the job is figured. A good many contractors have been thinking along those lines in the past year or two.

Leadite Joints for Water Mains Save Money

LEADITE, as a joint filler for cast iron water mains, is much cheaper than lead, and it has given satisfactory results. An example of its use was cited by Homer R. Turner, superintendent and engineer fire district, Windsor, Conn., in a paper read before the New England Waterworks Association. An abstract of this paper follows:

In drawing up proposals for 28,000 feet of 10-inch cast iron water mains alternative prices were asked on lead and leadite joints. The contractor to whom the work was awarded offered to do the work with leadite joints for 10c. per foot less than with lead joints. After favorable replies were received from several users of leadite, we determined to use the material.

Heated in Coke Furnace

Leadite comes in the form of a black powder, put up in 100-pound bags. We used an ordinary portable furnace, burning coke, controlling the temperature by dampening the fire with soil when necessary. One attendant is kept on this furnace continually, as the material requires constant stirring and proper control of the temperature to prevent burning. The leadite is melted until it is of the consistency of medium oil and the appearance of the surface of the liquid is smooth and free from bubbles. At this stage it has a mirror-like surface, and is ready to pour. The temperature at this time is very slightly above the melting point, and a higher temperature will cause bubbles to appear. Any increase in temperature will cause the material to thicken until it becomes stringy. If this occurs the pot should be removed from the fire and cooled until the temperature is reduced so that the material is of the proper consistency.

Dry jute should be used in the joints, as the presence of oil or grease from tarred jute prevents a good bond between the leadite and the cast iron pipe. The material is poured similarly to lead, it being necessary, however, to build the gate at least three inches above the top of the bell. This is required, as the material is too light to flow back into the joint at the top of the bell of the pipe without a slight head to force it. Joints made up with an ordinary gate, such as is used for lead, proved to be imperfect, as the material did not properly fill the joint at the top. The leadite in the gate can be broken from the joint when cold and remelted after being properly cleaned.

We obtained better results with the joints when the pouring was kept back at least four lengths of pipe from the laying gang. The shock of driving home a new length of pipe tends to break a freshly-made joint.

Has Tendency to Crack

One serious disadvantage in the use of the material is its tendency to crack, it being brittle on new work. One 6 in. pipe crossing laid under a railroad track in 1914 has broken down at the joints, and it has been necessary to cut out the leadite and use lead in this location. Another disadvantage of leadite is that in repairing a defective leadite joint it is necessary to shut the water off the main. It has been found impossible to caulk or patch a leadite joint with lead wool or other material. Best results are obtained by entirely removing the leadite from the joint and either repouring joint with leadite or lead. On the other hand, the ease with which plugs can be cut out or joints cut away in order to remove several lengths of pipe has proven of distinct advantage.

As the standpipe was not completed when the pipe lines were laid, we were forced to omit exact tests of joints after pouring, but each joint was inspected when a section was filled with water before back filling was done. Final tests were made this year.

Leakage Tests

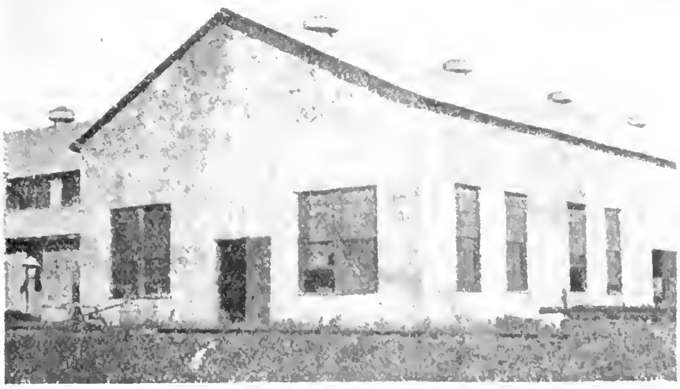
The only method available in making these tests was to shut off each service connection at the curb cock and to shut off all gates on adjacent lines. No doubt some of the water measured as leakage was lost through leaky services or gates, but the results have been figured on the assumption that the total loss of water was through the leadite joints only. The standpipe was pumped full of water to give the maximum available pressure on the lines to be tested. The pressures on 35 per cent. of the line tested ranged from 45 to 70 pounds, and on 65 per cent. from 70 to 98 pounds per square inch. The duration of the test was four hours. The actual quantity of water registered through the meter was 39.4 cubic feet, or 1,773 gallons per 24 hours. Correction for under-registration of the meter gave a total loss of water from leakage of 1,861 gallons per 24 hours, or 0.36 gallons per 24 hours per lineal foot of joint.

Gunite Protection for Steel Buildings

Cement Gun Makes Corrugated Steel-Clad Structures at Plant of Dominion Natural Gas Company Proof Against Corrosion

GUNITE, the product of the cement gun, has proven eminently satisfactory as a protective coating for steel. It not only acts as a fire-proofing material, but it serves to prevent corrosion and rusting. Owing to the dense nature of the material, gunite has special advantage over hand-placed concrete and at the same time is more adherent, and in its placing requires less labor and fewer materials. Many buildings are now being constructed with exterior walls of gunite, reinforced with expanded metal or some special fabricated steel reinforcement. In buildings where there are corrosive gases, gunite has been adopted in many instances because of its impervious properties and the protection which it affords to steel.

An instance of this kind where gunite proved useful is described in this article. The primary purpose of the gun-applied mortar was to offset the corrosive effects of sulphuretted gases on steel framework and corrugated steel covering. At the same time, the gunite made a more permanent and durable wall. Its application was carried out without closing down the plant.



Gunite shot on these steel buildings with the cement gun proved effective in offsetting corrosive effects of sulphuretted gases.

The subject of this article is the plant of the Dominion Natural Gas Company, which is included among the many subsidiaries of the Cities' Service Corporation, of New York, which comprises many well-known public utilities, owned by the Henry L. Doherty interests. The Dominion Natural Gas Company operates in the Tilbury, Ont., gas fields, in distributing natural gas from London to Hamilton.

In order to supply the large demand for this gas the company have built at Glenwood, Ont., a large plant, consisting of machine shops, gas pumping station, purifier building, together with offices, etc. These buildings were erected of corrugated, galvanized sheet steel, covering structural steel frames, and vary in size from 20 feet by 30 feet to 60 feet by 170 feet.

Gases Corroded Steel

It was soon found, however, that, owing to the presence in the raw gas of a considerable amount of sulphur, the corrugated steel corroded very rapidly, and no method of painting or other usual protection remained effective for any length of time. In addition to this, the buildings were very cold in winter and unbearably hot in summer.

In July, 1917, the Dominion Natural Gas Company requested the Burns Cement-Gun Construction Company, Toronto, to give them an opinion as to the practicability of covering their buildings with reinforced Gunite, both inside and out, without the use of forms. After investigation, it was decided that this method would be the most practicable, and a contract was entered into with the Burns Cement-Gun Construction Company to proceed with the work.

Poultry Wire Reinforcement

The sides and roofs of the buildings were first covered with heavy poultry wire, stretched taut and fastened on with tie wires passing through holes punched in the galvanized iron, and tied inside the building round the structural steel members. Over this was shot a coating of Gunite averaging two inches in thickness, consisting of one part portland cement and three parts sharp sand. The material adhered perfectly to the building and set very hard within twenty-four hours; when set the material had the characteristic glossy waterproof finish of Gunite, and on being struck with a hammer gives out a sharp, ringing sound, indicating the great density of the material obtained by this method of construction.

The Dominion Natural Gas Company have expressed great satisfaction with this work, which did not in any way interfere with the continued operation of their plant, and which, in addition to absolutely preventing any further corrosion, makes their buildings much warmer and still further reduces the fire risk.

Newly Elected C.S.C.E. Members

The following have been elected members, associate members, juniors, etc., of the Canadian Society of Civil Engineers:

Member—Mr. Arthur D. Little, Brookline, Mass., president of Arthur D. Little, Ltd., Montreal, chemical engineer.

Associate members—Mr. D. Waters Houston, Regina, Sask., superintendent in charge of construction and maintenance, Regina Municipal Railway; Mr. E.

P. McKie, Victoria, B.C., Water Rights Department, British Columbia Government; Mr. A. L. Morgan, Montreal, assistant inspector of shells in charge of Lachine district; Mr. Patrick Philip, Kamloops, B.C., district engineer in charge of District No. 3, Department of Public Works, B.C.; Mr. A. S. Wall, Montreal, Dominion Bridge Company, making detail drawings, etc., designing steel structures.

Juniors—Mr. M. L. Boswell, Victoria, P.E.I., lieutenant in Canadian Engineers, St. John's, P.Q., prior to which he was assistant to resident engineer at Halifax Ocean Terminals; Mr. R. W. Coke, O. C. Army Service Corps, Mechanical Transport, attached to 227th Siege Battery, R.G.A., prior to which he was with the Northern Ontario Light and Power Company.

Associate—Mr. J. Gosselin, Jr., Levis, P.Q., vice-president and general manager, Joseph Gosselin, Ltd., contractors and engineers, Quebec and Levis.

Transferred from junior to member — Mr. E. G. Hewson, Toronto, divisional engineer Ontario lines, G.T.R.

Transferred from junior to associate member—Mr. C. B. Archibald, West Wabana, Newfoundland, Nova Scotia Steel and Coal Company, chief engineer in charge of civil, mechanical, and electrical department, including mine surveying; Mr. P. Kolling, Victoria, B.C., chief draftsman, C.N.P. Railway; Mr. O. W. Martyn, Swift Current, Sask., engineer and surveyor, firm of Martyn & MacDonald, consulting engineer of the rural municipalities of Miry Creek, Whiska Creek, Glen Basin, Riverside, Lacadena, Ponteiux.

Transferred from student to associate member—Mr. Mr. D. A. R. McCannell, Regina, Sask., acting city engineer of Regina; Mr. A. Pepin, Quebec, inspector of concrete highways, Highway Department, Quebec.

Transferred from student to junior — Mr. G. W. Ross, Montreal, at present overseas, formerly shop supervisor British Munitions, Verdun.

New Methods Reduce Cost of Brick Roads and Give Superior Results

By William C. Perkins*

DURING the past two years the method of constructing brick streets and highways has radically changed. New methods of construction have materially reduced the cost of brick pavements and at the same time have greatly improved the pavements themselves by giving them greater rigidity and durability.

The defects which occur in the brick-wearing surface of many roads have been carefully studied by paving engineers, and a new type of construction evolved, one which eliminates the idea of the necessity of a resilient bed or cushion between the brick wearing surface and the foundation, and substitutes the laying of the brick directly upon a non-shifting, non-shrinking, rigid foundation, and thus making the wearing surface and foundation practically a monolith.

New Types of Construction

Two methods of construction are being used:

1. The laying of the brick directly in the green or newly-laid concrete, commonly called "the monolithic construction."

2. The laying of the brick on a superfoundation of cement-sand, the cement and sand being thoroughly mixed and spread on the prepared foundation, the bricks after being rolled being well wet down, the cement and sand thus forming a mortar bed, which unites the wearing surface and the foundation. This method is commonly called "the semi-monolithic construction."

Each type has its place, and the results obtained in practice are practically the same. The monolithic type is generally used in the construction of roads and streets whose width does not exceed 24 feet, and where the grades and cross-section are uniform. There are instances, however, where it has been used on wider streets with success. The semi-monolithic type is the general method used for city streets, especially if there are many intersections or much change in cross-section. Sometimes the two types are combined, a layer of cement-sand being placed on the green concrete, or on the concrete foundation before it has well set up.

A Strong and Rigid Pavement

From a theoretical viewpoint the laying of the brick directly in the green concrete should give the truest monolith; but the results obtained with the cement-sand superfoundation have proven that, for all practical purposes, as strong and rigid a pavement is obtained with this type. Therefore, the engineer in preparing his plan and specifications should be governed by local conditions as to which type to use, being assured that the essential feature of each type is a rigid beam from wearing surface to sub-grade.

Since the advent of the monolithic and semi-monolithic construction there is a tendency among paving engineers to reduce the depth of the brick from 4 in. to 3 in. No brick pavement has ever failed by the actual wearing away of the brick wearing surface.

Three Inch Brick Is Used

We certainly have a stronger pavement with bricks laid monolithically than laid with a sand cushion. Assuming a grouted brick pavement as a beam to hold the weight of traffic or the heavage of frost in these northern latitudes, consider the old type of construction, a 4 in. brick laid on a 1½ in. sand cushion on a 5 in. concrete foundation. In the old type we have two beams acting independently, the sand cushion having no bonding strength, and, as the strength of beams vary as the square of their depth, the comparative strength of this type is 16 for the brick and 25 for the concrete, or a total of 41.

Now, consider a 3 in. brick laid monolithically in a 4 in. concrete foundation. In this type of construction the brick are well bonded together and also bonded to the foundation, and we practically have a 7 in. beam which has a comparative beam strength of 49. Therefore, the monolithic type saves 1 in. of foundation and 1 in. of brick surfacing, and we have a relatively stronger pavement than with the sand cushion. This opens

* Chief Engineer, Dunn Wire-Cut Lug Brick Company.

up to the paving engineer the economic design of pavements.

Three Inch Brick Saves Cost

If a 3 in. brick laid directly in the green concrete, or on a cement-sand superfoundation, will give as durable a wearing surface as a 4 in. brick (we would not advise the use of a 3 in. brick on a plain sand cushion), there would be considerable saving in the cost of brick paving ,especially in districts at a distance from the brick plants. The paving engineer in preparing his estimates, should investigate the saving of 1 in. of brick as compared with 1 in. of the prepared foundation, and prepare his plans and cross section of pavement accordingly.

In the manufacture of 3 in. paving brick there is a little saving in cost at the plant. The main saving, however, is in the transportation charges. A thousand 3 in. paving brick weigh about 7,500 pounds, which is a saving in weight of approximately 2,500 pounds over that of a 4 in. brick. To the contractor there is a considerable saving in the use of a 3 in. paving brick. He can haul one-third more brick per load; the manipulation of handling and laying is faster; they require one-fourth less grout or bonding material and also require less excavation. Many engineers are taking advantage of these savings, and there has been an increasing demand for 3 in. brick.

No Detail Too Unimportant

In constructing monolithic and semi-monolithic roads and pavements the personal equation of the engineer or inspector in charge is an important factor; no detail is too unimportant to require his careful attention. The actual methods of construction are in a formative state. There are isolated instances of pavements in which brick have been laid in green concrete or on a cement-sand bed, but the laying of brick in large quantities by these methods is a development of the last two years.

The details of construction will not be outlined here, as articles in the Contract Record at various times, notably one in the Oct. 11, 1916, issue, described fully the procedure to be followed in building monolithic and semi-monolithic brick surfaces. Suffice it to say that as much care must be used in the preparation of subgrade and concrete foundation as in the preparation of the green concrete or cement-sand bed and the laying and grouting of the brick. No slipshod method must serve. Good construction is obtained by close cooperation between the inspector and the contractor. Intelligent, conscientious, and efficient work is necessary.

Contractor and Inspector Can Give Close Attention

One of the many advantages of monolithic construction is that the different stages of work are all going on at the same time and practically by one organization, under one head. The contractor is working on the concrete foundation, laying, inspecting, rolling, and grouting the brick within a restricted area. At the end of a day's work he should have a completed brick roadway. The work being thus confined to a small area, the contractor and inspector are able to give closer personal attention.

Rigidity is the fundamental principle of the monolithic and the semi-monolithic construction, and rigidity requires a firm bonding together of all parts of the pavement into a solid beam or monolith.

It does not suffice that the brick wearing surface be firmly bound to the foundation, but each individual brick in the wearing surface must be strongly bonded together or the breaking of the bond in the joints will cause the brick to cleave from the foundation. It is essential, therefore, that the brick used should be of such a type as to obtain the maximum bonding strength with a cement grout filler. Therefore, a square-edged, rough-sided brick, with four contact lugs of uniform height, so as to insure a uniform joint, should be used.

The rounded edges of the brick are of no value; they decrease the bonding surface of the joints by at least one-half inch. They do not hold the grout under traffic, as it easily chips out from the rounded edges—in fact, there is no reason, from any viewpoint, why the edges of the brick need be rounded.

Lugs Should Be Uniform

Specifications should be more definite in regard to uniformity and shape of lugs on brick. Paving engineers carefully inspect the surface of their pavements, culling out all soft, chipped, kiln-marked, and brick detrimental, but allow a pavement to be built with lugs so small or so malformed that it is absolutely impossible for the bonding filler to get between the bricks and penetrate to the bottom of the joint. Many of the imperfections in brick pavements are due to the lack of penetration of the cement grout between the bricks, and engineers should inspect for uniformity of lugs, thus insuring a perfect bonding space between the bricks. Bar lugs or raised letters should not be allowed, as they have a tendency to pocket the grout or cause same to bridge, forming bad joints. The lugs should be four in number, and merely points of contact. The ends of the brick should be provided with a bulge or some other device, so as to insure a proper penetration of the filler. The bonding surfaces should be rough, so as to obtain a greater adhesion of the cement filler, and thus a much stronger bond is obtainable.

Wire-cut lug bricks were specially devised to meet these requirements, and they are now made by all the larger paving brick plants, and are sold at the same price as the old type of brick. Many paving engineers, recognizing the superiority of this type of brick, are specifying it for monolithic and semi-monolithic construction.

From the viewpoint of economy the new methods of constructing brick pavements effect a saving in the actual cost of construction and at the same time increase the life or durability of the pavement.

Curb Unnecessary

1. On roads and highways where in the past it has been necessary to use a flush edging or curb to hold the brick, the monolithic construction makes the edging and the accompanying longitudinal expansion cushion unnecessary. Experience has shown that the rigidity of the pavement is such that there is no displacement or breaking away of the bricks and practically no abrasion from traffic on the edges of the roadway. This elimination of the edging is a material saving in cost of construction. In city street work where a curbing is necessary for drainage purposes, we believe that the longitudinal expansion cushion need only be ½ in. in width for streets up to 50 feet in width, but that it should extend the full depth of the pavement—that is, from the top of the brick to the bottom of the concrete foundation. Two premolded or prepared bituminous strips are recommended for this purpose, one to be placed when the concrete foundation is being prepared, the other when the brick is being laid.

2. During construction the contractor profits by a

saving in overhead charges, superintendence, foremen, etc. The work, being confined to restricted area, requires less high priced labor and also enables the contractor to have a more compact organization. There is also a saving of interest on money invested, for at the end of each day's work there should be a section of pavement ready for acceptance.

Flexibility of Design

3. To the paving engineer there is economy, for owing to the flexibility of design he can design his pavements to meet existing conditions, increasing the depth of his concrete foundation where necessary, and knowing that he is then increasing the strength of his pavement; while, under the old construction, he had no assurance of added strength when he used a deeper foundation, for the effect of the sand cushion was to practically make the brick wearing surface take the weight of traffic.

To summarize: the durability and life of a brick pavement depend upon three essentials: good design, good material, and good construction. As a bulletin of the United States Department of Agriculture states: "The life of a well-constructed brick pavement cannot be estimated with any degree of exactness—first, because the traffic conditions are constantly changing; and, second, because no brick pavement which has been constructed with the best modern practice has yet worn out."

Grand Trunk Railway Planning Long Bridge at Campbellford, Ont.

CONTRACTS for the construction of a new bridge at Campbellford, Ont., have been let by the Grand Trunk Railway. The superstructure will be built and erected by the Hamilton Bridge Company and the substructure built by the Foundation Company, Ltd., Montreal. The construction of the bridge, together with approaches to give the necessary clearance for shipping, is due to the construction of the Trent Canal. The new structure will be situated 25 feet south of the present bridge, with 29 feet clearance above high water level. It will be single track, and will consist of seven spans, as follows: Four deck plate girders, 35 ft. 4 in. each; one through plate girder, 98 ft. 11 in.; two deck plate girders, 99 ft. 8 in. each; and one deck plate girder, 35 ft. 10 in.—a total length of 269 ft. 9 in.

The approaches to the bridge make it necessary to raise the present embankments from 5 to 20 feet above the present level. The abutments and piers will be constructed of concrete.

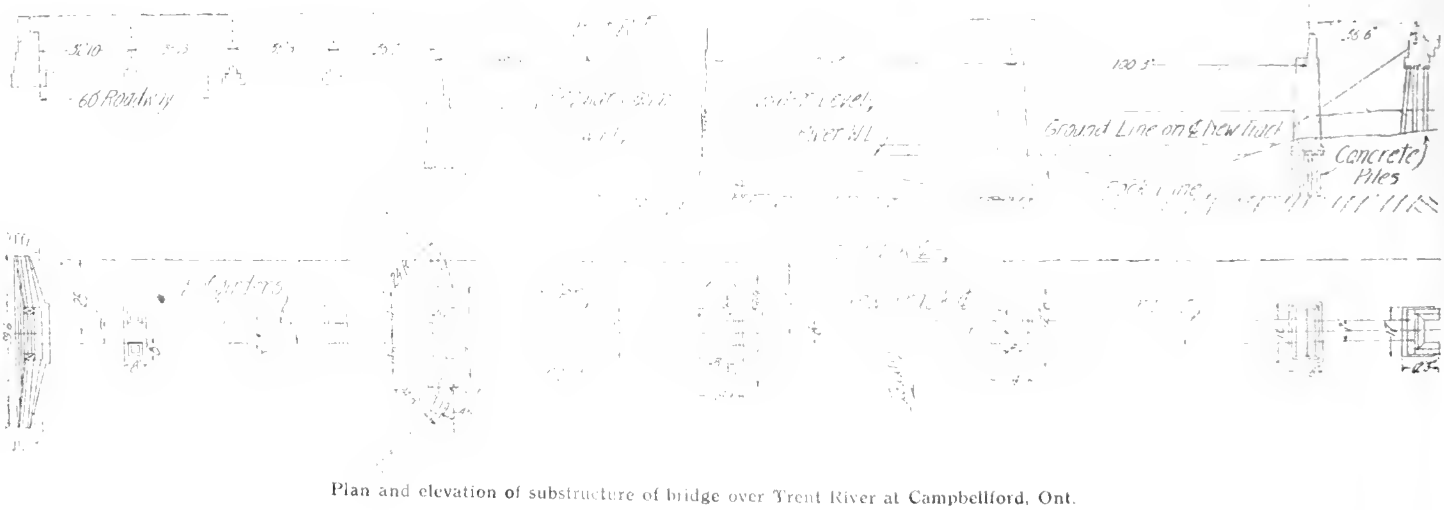
Alignment Altered

The new bridge tangent connects at the east end with the present main line by a 1 degree curve, and the west end intersects the present tangent at the west end of the Campbellford yard. The approach grades to the bridge will be 0.76 per cent. eastbound and 1.5 per cent. westbound. The material for raising the embankments is being taken from the cut at the west end of the work, about half a mile from the bridge. This permits of the alignment through the cut being reduced from an 8 degree curve to a 1 degree curve.

The railway company are doing the necessary grading and track changes with company forces, all under the direction of Mr. H. R. Safford, chief engineer, and Mr. A. S. Going, engineer of construction. Mr. W. G. Swartz is resident engineer in charge at Campbellford.

No Traction Engines on Roads in Spring Time

The Michigan Legislature has recognized changed traffic conditions by enacting a statute making it unlawful to move any traction engine or similar heavy machinery over the public highways, by its own power or otherwise, during the months of March, April, or May; or at any other time if the roads are unfit for the passage over them of such heavy machinery without damage to them, by reason of rains, thawing of frost, or any other cause. A new law was also enacted regulating the loads which may be hauled over public highways upon any given width of tire. This act applies to both horse-drawn and motor-driven vehicles.



Plan and elevation of substructure of bridge over Trent River at Campbellford, Ont.

Recently Published Results of Road Traction Tests Do Not Consider Grades

Editor Contract Record:

The tests for tractive resistance of pavements made in California and described in the Sept. 19 issue of the Contract Record are interesting, but are deficient because they do not take into consideration the influence of grades.

From experiments made by the writer and published several years ago, it was found that the increment in tractive force was practically uniform for reasonable grades, and by measuring the gradients a definite figure could be arrived at for zero grade, after plotting the curves representing the observation.

The following is a condensed tabulation of tests made for the city of Toronto in 1908:

Kind of pavement.	Resistance on level grade. In dry warm weather.	In wet cool weather.	Additional resistance for each per cent. of grade. In dry warm weather.	In wet cool weather.
Brick	35.4	18.3	....	....
Bitulithic	42.5	19.5	35.4	17.1
Treated wood block	47.8	17.7	40.7	21.3
Cedar block	62.5	19.7	74	18.5
Asphalt	67.3	26.1	56.7	14.8

Assuming that the tests were made with equal care and accuracy, brick, bithulithic, and treated wood block offer less resistance than tar-surfaced concrete pavement. Note the marked improvement in asphalt when the pavement is cool and hard.

The cedar block type was usually in poor shape, consisting of round blocks, sand-filled and laid on concrete base.

The data from both the California and Toronto tests appear to check fairly well, and the tests of the Good Roads Bureau are a welcome addition to the literature on the subject.

Yours truly,
A. D. Blanchard.

Bricks of Cement, Clay and Shale Burned Under New Process

A NEW era in brick-making has begun with the the manufacture of bricks composed of portland cement and clay and shale burned under a new process. After long years of study and experimental work, and under most rigid testing, this brick has been demonstrated to be fully the equal of the present-day commercial clay or shale brick and is superior in many of the more important features.

Burning of Clay and Shale the First Step

The first step in the process of manufacture of this brick is the burning of the clay and shale. A 16 ft. portable rotary kiln, with a capacity for burning approximately 100 cubic yards of material each 24 hours, is used for the purpose. From 1,700 to 2,200 degrees Fahrenheit are required to sufficiently burn the clay and shale, the variance being governed by the class of clay and shale being handled. The burned material is allowed to remain where discharged from the kiln to cool in the air, and is then well sprinkled with water to slack any lime particles that may be present. The second step of the process is the reduction of the burned material to pass a half-inch mess screen, which produces four sizes—i.e., impalpable dust to that passing a 60-mesh screen; that passing a 10-mesh screen; that passing a 4-mesh screen, and that passing a 2-mesh screen.

The material is then ready to be mixed according to formula worked out to best meet, in combination with portland cement, the requirements for the brick to be made. Proportioning the aggregate to the cement is the next step. This follows closely the practice for sand and stone concrete. The only notable feature of the mixing is the amount of water used, which approximates 20 per cent. by volume and which is ample to start the chemical action in the cement. The mixer is located directly above the press, the mixed concrete being conveyed from the mixer to the press through metal chutes. The brick are discharged from the press on pellets which are stacked and allowed to remain undisturbed for from 12 to 24 hours, when the bricks have attained sufficient strength to be "hacked" into piles to cure. With the exception of an occasional sprinkling to prevent too rapid drying out, the brick need no further attention. After from eight to fourteen days the brick are ready for delivery to the building, sewer, or other work in which they are to be used. When completely cured, the bricks are several shades lighter in color than the usual "concrete" gray.

Saving of 1,500 Pounds Per Thousand

These burned clay and shale concrete bricks will strongly appeal to the building and construction industries. The fact that they weigh but approximately four and one-half pounds as against the standard six-pound clay and shale brick—a saving of 1,500 pounds per thousand of brick—will solve much of the sometimes vexing problem of reducing the dead weight in buildings. The light weight of these brick will also recommend them in many other particulars to the architect and engineer. They readily recommend themselves to the builder and contractor because of the rapidity with which they can be laid and the true and even walls which it is possible to construct with them.

For the brick manufacturer, burned clay and shale concrete bricks should prove most acceptable, as they are said to possess all of the desirable features of concrete, some desirable features not possessed by concrete, and yet they have the flexibility of brick and are a better brick than can be manufactured with clay or shale in their natural state. At a very small expense for additional equipment and without interfering in any way with the production of regulation clay or shale brick, the brick manufacturer can very profitably add these new concrete bricks to his line.

Water Meters Reduce Consumption by Preventing Waste

THAT meters cut water waste is the argument of S. E. Killam, superintendent of pipe lines and reservoirs, Boston, presented in a paper before the New England Waterworks Association. Waste of water can be divided into two classes—leakage from mains and waste from service pipes. The first can be stopped by efficient management, but the latter, according to Mr. Killam, is counteracted by enlisting the consumer's co-operation by giving him a direct pecuniary benefit. The best way to get results is to sell the water by measure, and to keep the measuring devices in good working condition.

Meters Effect Saving

The experience of the metropolitan water district of Boston was cited to show wherein meters affect

*Chief field engineer, Niagara development, Hydro-electric Power Commission of Ontario.

consumption. Since 1908 all cities and towns deriving their source of supply from the metropolitan waterworks have had all new service pipes equipped with water meters, and every year at least 5 per cent. of the unmetered services existing at that time were further equipped. The quantity of water consumed became a very important element, and it was an incentive not only for the district as a whole, but for each municipality, and, finally, the most important of all, for each consumer, to check and stop the unnecessary and wasteful consumption of water. The average daily consumption of the inhabitants, due directly to the gradual installation of more service meters in the district, was reduced from 130 gallons in 1907 to 89 gallons in 1916. There has been a gradual reduction in the quantity of water used with the increase in the use of meters. One municipality shows that since the introduction of meters the records on the master meter have indicated a saving of 55 gallons per capita in two years, a reduction of 46.7 per cent.

Notwithstanding an increase of 350,000 in the number of people supplied in the whole district, the average daily consumption was less in 1916 than it was in 1899. The average daily quantity of water used in the district in 1916 was 17,808,000 gallons less than during the year 1908, and the per capita consumption has been reduced from 130 gallons to 89 gallons.

Meters Made Plant Extension Unnecessary

It is stated that if the conditions which existed prior to 1904 had been allowed to continue, additional sources of supply would, without doubt, have been required before the present time. It is also probable that had legislation not required the installation of meters additional works would have been necessary by 1920.

Mr. Killam believes that water meters are as much a part of a well-operated waterworks system as gas or electric meters are to their respective works. Many gas companies account for 80 per cent. of gas delivered through the master meter. As far as water supply is concerned, well-managed waterworks in Europe account for all but 10 per cent. of their supply.

The total cost to Jan. 1, 1917, of installing the meters, including meter registers and appurtenances, was $94,364. The total cost for charts and repairs to meter registers since their installation in 1903 averaged about $3.50 per meter register per year.

Electrolysis in Underground Water Pipes

Cast Iron Less Subject to Damage on Account of Greater Resistance and Lead Joints—Perfectly Insulated Return Circuits the Only Remedy

VERY soon after electrically-operated railways were introduced, underground piping systems began to show damage from electrolysis. Prior to that time little or no trouble had been experienced. With the multiplication of electric car lines the situation has become more serious, and today the problem is receiving much attention.

Electrolysis from Stray Currents

Most electric railways in this country employ direct current, the power being supplied to the cars through an overhead trolley wire and the return circuit to the power-house being completed through the running rails. It is common practice to lay these rails with the tops flush with the street surface. Under such conditions the major portion of the rail area is in direct contact with the street soil, or where concrete has been used as a base, in contact with this. The water found in such soils (or concrete) usually contains salts, acids, etc., sufficient to make it capable of electrolytic conduction; hence either the wet concrete or wet soil is capable under ordinary conditions of conducting electric currents. Current from the return rails that flows or leaks into the soil or concrete must find its way back to the power-house through some underground path.

Underground water piping systems readily offered themselves as convenient conductors of these stray currents, especially where the rails cross, or parallel in close proximity the pipe. In general, these currents flow along the pipe until they reach the neighborhood of the power-house, and at the nearest point to this leave the pipe, return through the soil to the rails, and thus back to the negative terminal of the generator. These currents do no harm to the pipe except where they leave it, and at such points the pipe is corroded or eaten away.

In addition to the damage occurring in the locality of the power-house—which is by far the greater and more serious source of trouble—the pipe is also affected at other points where for certain reasons currents leave the pipe, either to shunt around some high-resistance section or to return to the rails because of favorable soil conditions and possible close proximity of the tracks. Particularly in the case of cast iron, where there is a more frequent possibility of some lengths of pipe being of unusual high resistance, or the lead joints are so made that the pipes themselves are not in direct contact, the current flowing sometimes shunts around such high-resistance pipes or joints. However, this is really an advantage rather than a disadvantage, because it exerts a strong tendency to keep the total current low, causing, as it does from time to time, a portion of what would be final accumulated current to leave the pipe and seek some other path, such as the rails, back to the power-house. Obviously, in general, under these conditions the total current leaving the pipes at the power-house is small—much smaller than the accumulated current would have been had there been no loss or leakage as here described. Wherever the pipe lines parallel the rails and pass through unusually wet soil there is more danger of serious trouble, such conditions lending themselves readily to the passage of current to and from the pipe or rails.

Small Possibility of Damage in Cast Iron

Under similar conditions with currents of equal strength flowing through iron pipes, the amount of metal destroyed is the same, whether the pipe is steel, wrought or cast iron. However, due to its inherent qualities and peculiar metallic structure, the resistance offered to the flow of electricity by cast iron is, roughly, ten times as great as steel or wrought iron, and the ordinary lead joints employed with cast iron increase this resistance materially, thus reducing proportionately the current flowing, which makes the possibility of electrolysis in the case of cast iron approximately one-twelfth what it would be for the other two kinds of pipe mentioned. It should also be borne in mind that in practice cast iron pipe has a metal thickness about four times that of wrought iron or steel, which proportionately delays the ultimate total destruction in the case of this class of piping.

If pipe is of steel or wrought iron, results of electrolysis are seen in pits, these finally extending through the plate. Where the current leaves such pipe the metal is converted into iron oxide, which is frequently noticeable in surrounding soil. If the pipe be of cast iron, the oxides formed often are still held in position by the graphite, and the external appearance of the pipe remains unaffected. When the pipe has been entirely eaten through, the mass is about the hardness of pencil lead, and collapses under an ordinary hammer stroke, yet a pipe in this condition, if the soil is rather tightly packed about it, may remain without leaking for a considerable period. It is frequently necessary to make a direct physical examination of a pipe and subject it to a hammer test to determine if it has been attacked by electrolysis.

Trouble in Service Pipes

While less serious, probably the greater percentage of damage actually occurs in the service pipes, because these frequently pass under the car lines close to the rails, and pipes, being relatively thin, are quickly pierced. Investigation made in about fifty cities brought out the fact that, roughly, 75 per cent. of the trouble experienced occurred in the service pipes, lead, wrought iron or steel, all being readily affected. Besides the damage to the service pipes themselves, stray electric currents flowing on these may occasionally reach the steel structure of buildings, causing electrolysis to attack the steel, but seldom to any serious extent. Under certain unusual conditions, current flowing on these service pipes may be sufficient to raise them to a temperature approximating red-heat, and in this way cause fires. In some cases of gas pipes explosions have been brought about. However, such occurrences are undoubtedly very rare at the present time, and there seems no good reason to anticipate any increase in this hazard.

Electrolysis from Local Action

Self-corrosion, in which the current originates on the metal itself, may take place, and is due in the case of pipe to the impurities of the metal or the presence of carbon or coke in the surrounding earth, or both. Salts and acids in moist soil increase this action. Small pieces of coke or carbon in wet soil in contact with the pipe, even if no physical differences between adjacent parts of the metal exists, will bring about local action. An instance of this kind came to the writer's attention where a large coated steel pipe passing through a cinder bed failed completely in a short time, the metal structure of the pipe becoming a mere honeycomb of rust.

However, it should be stated that, in the case of cast iron at least, except where this is laid in excessively damp cinder beds or like materials, the local action is very seldom, if ever, sufficiently severe to cause the entire destruction of the pipe within the period of years usually ascribed to the life or usefulness of the ordinary pipe line. In other words, since practically all of the mains and distribution systems in the great majority of our cities consist of cast iron, there is not much trouble to be expected, except under unusual local conditions, from electrolysis other than that caused by stray currents that have leaked from electric railway systems. Owing to the present growth of the interurban lines, even many small towns and cities that have no street railway systems of their own are no longer free of possible trouble from electrolysis. Hence this is a subject that demands attention from both towns and cities.

Mitigation of Electrolysis

Many patented devices or so-called "mitigation systems" have been brought out, and in some instances these have seemed to work out very satisfactorily. In other cases results have not been so good. Local conditions differ so widely that a system which might answer in one city would do very little good in another. The writer considers these systems still in the experimental stage. In this country many cities have attempted to lessen the evil by bonding at frequent intervals the pipe to the rails, employing some good conductor like copper wire in this operation. In most cases this method has been attended with only indifferent success, and is more likely to prove a detriment than a help, because it is liable to increase rather than decrease the current leaving the pipe at points not in the neighborhood of the power-house, as the bonding would have a tendency to cause a larger current flow than would otherwise be the case.

From time to time in recent years a great many paints, dips, tars, and fabric coatings and various so-called "insulating coverings" have been on the market and claims made of their worth, but so far, after extensive experiments and practical tests, it is yet to be proven that paints, coverings, fabric and otherwise (except possibly asphaltum of one or two inches in thickness), are of much, if any, value. Tests made have only served to emphasize the fact that many of these coverings, such as pitch and burlap wrappings, increase rather than decrease the action of electrolysis.

Return Circuit Must Be Insulated

Certain rather satisfactory results have been obtained by introducing insulating joints in pipe lines at proper intervals. Further developments along this line promise good results, provided experiments prove that the insulating joints can be inserted economically. Some cities have spent quite a little time and money in drainage experiments, their purpose, of course, being to remove as much as possible of the water from the soil and thus reduce the likelihood of electrolytic conduction. So far these experiments have not been productive of very good results, and the opinion seems to be growing that the cost is excessive in comparison with results obtained. To sum up, so far the only method yet developed of securing absolute immunity from electrolysis is to perfectly insulate the return circuit. Several cities have accomplished this by providing an overhead return wire. Others have their return circuit through insulated underground conduits. At present a committee composed of leading men from engineering societies and kindred associations, organized into what is known as the "American Committee on Electrolysis," are giving the subject of electrolysis mitigation very close study, and it is to be hoped that their findings, when made public, will go far towards settling this rather distressing problem.

From the foregoing statements and investigations the following conclusions are drawn by J. W. Ivy, of the American Cast Iron Pipe Company, in a paper before the Southwestern Waterworks Association, from which the above article has been prepared:

1. The possibility of electrolysis trouble increases as electric tramways become more numerous and the loading becomes heavier.

2. Stray currents are the principal and most troublesome source of damage. This damage is confined entirely to points where currents leave pipes.

3. Anodic corrosion in underground pipe lines is directly traceable to currents that have leaked from imperfectly insulated return circuits of electric tramways.

4. The really serious damage to supply lines and distribution systems proper is confined in the main to the neighborhood of the power-house, except under certain peculiar local conditions, such as unusually wet soil, cinder beds, etc.

5. Service pipes furnish the greater number of failures in a short period of time, and for this reason are generally regarded as the seat of probably 75 per cent. of the total trouble, lead, steel, or wrought iron all being readily attacked.

6. The higher electrical resistivity of cast iron and the extra thickness of metal presented greatly reduces the possibility of ultimate destruction in this class of material as compared with ordinary steel or wrought iron pipes.

7. Self-corrosion, except under extremely trying conditions, is seldom, if ever, sufficiently serious to cause complete failure of cast iron, though it might destroy iron of thinner structure.

8. Paints, dips, fabric coatings, etc., are of little or no value in mitigating electrolysis, fabric coatings especially rather tending to increase than decrease the damage.

9. Better bonding of rails, introduction of insulating joints, and like remedial measures, have so far proven the most helpful in electrolysis mitigation.

10. Only perfectly insulated return circuits offer absolute immunity from stray current damage.

Asphalt Company Can Collect Damages Incurred Through Loss of Profits

In the Court of Appeal of the King's Bench Division recently, judgment was given reversing a decision of the Superior Court in which Mr. Justice Lafontaine dismissed the principal action of the Elder Ebano Asphalt Company, Ltd., who sued the city of Maisonneuve for $44,659.33 damages, alleged to have been suffered by the company through loss of profits on asphalt which ought to have been supplied to the city. The company's action was based on a contract made with the city of Maisonneuve in which the latter agreed to purchase the whole of the asphalt the city required during 1915 exclusively from the company. There was an extension of this agreement afterwards, and the terms of this extension laid down no limit of time during which the city was to continue to purchase its asphalt from the company. When the city went elsewhere for asphalt, the company alleged breach of agreement and took action to recover damages to cover the margin of profits which would have accrued to them had they received the orders. Justice Lafontaine had thrown out the company's action on the ground that such an agreement as was alleged would be contrary to the natural liberty enjoyed under the law governing buyer and seller. Justice Carroll, in pronouncing the majority judgment of the Court of Appeal, said it was evident that the court of first instance had interpreted the original contract and the subsequent extension as forming a contract which ought to be considered as one single contract. There was no doubt that under such an interpretation the whole must be considered null, as being a contract contrary to public order. But the majority of the court held that the stipulations of the original contract and the stipulations of the extension of agreement between the company and the city could be executed independent of one another. On this ground they held that, while the extension was null and of no effect because it created an illegal monopoly in favor of the company, the contract itself, as originally drawn up, did not fall to the ground at all, and under it the company lost profits, which the court assessed at $25,358. The court, therefore, held the city liable to the company for this amount.

Toronto Economizing in Expenditures

Works Commissioner Harris, of Toronto, recently submitted figures to the Board of Control showing the amount of money expended during the year 1914 to 1917, inclusive; also the number of employees on the staff of the department during the same periods. The figures show the extent to which Toronto has been economizing, as far as expenditure on public works is concerned, during the war. They include work done under capital expenditure and also local improvements. They are as follows:

1914	$5,885,011
1915	4,307,980
1916	2,571,061
1917, to June 30	730,238

The number of employees on the permanent rolls during the same periods were:

	On March 1.	On Aug. 1.
1914	864	961
1915	868	865
1916	742	712
1917	712	704

Pulp Concern Has Planned Model Town in Northern Ontario

Tentative plans for a model town near Temiskaming, Ont., have been drawn up for the Riordon Pulp and Paper Company, Montreal, who have under consideration the construction of a large pulp and paper plant. Mr. Thomas Adams, the town-planning expert of the Commission of Conservation, is the consulting engineer. Surveys have been made by Messrs. Ewing, Lovelace & Tremblay, of Montreal, and plans for heating and lighting by Messrs. C. H. & P. H. Mitchell, Toronto. At present the site is covered with bush. The preliminary plans show grades of from 3 to 5 per cent for the principal streets and a maximum of 8 per cent. for short lengths. Provision is made for parks, sites for churches, schools, etc. The main approach to the town will be by a street 80 ft. wide.

The first of the British Government's standardized merchant steamers to replace tonnage lost through submarines has been commissioned, having proved very successful under trial. It is understood that six different types of vessels, varying in size from 8,000 tons downward, are being built. Many hundreds of these ships are to be constructed.

Economics of Bridge Construction

Concrete, Plate Girder, Simple Truss, Cantilever and Swing Bridges Discussed from Viewpoint of Economy in Material and Cost

By J. A. L. Waddell*

THE economics of reinforced concrete bridges have not received much attention from technical writers. In general, it may be said that the unit costs are lower for those structures which have the simplest form-work; and a reduction will also be effected by decreasing the area of form-surface per cubic yard of concrete. For instance, in the case of a wall or slab the form-cost per cubic yard will vary practically inversely as the thickness of the said wall or slab. Evidently, therefore, it is desirable to concentrate the concrete into a few large members, rather than to employ a great number of small ones.

It should be noted that reinforcing bars less than ¾ in. in diameter command higher pound prices than do the larger bars.

Taking up, first, girder bridges carried on columns, the following points must be considered: First, the panel length, when cross-girders are employed; second, the number and spacing of the longitudinal girders; third, the number of columns per bent; fourth, the span length; fifth, the use of reinforced concrete piles to carry the footings.

Panel Length Not Important

The panel length adopted is usually not of great importance from the standpoint of economy. Lengths of from 8 to 10 feet are generally employed; but a considerable variation from these values will cause little change in the combined cost of the slabs and cross-girders. A reduction in concrete quantities can frequently be effected by using long panels, and by carryings the slabs on short stringers, supported by the floor-beams; but the extra form-work required will generally overbalance this saving in volume.

The number and spacing of the longitudinal girders will depend upon the width and the height of the structure, the span-length, and the load to be carried. For a high structure in which the economic span-length is fairly long, it will nearly always be found best to employ two lines of girders, the spacing thereof being equal to about five-eighths of the total width of the structure; but for bridges much over 60 ft. wide, the use of three, or even four, lines may be preferable. The slab in such structures is carried on cross-girders and cantilever-beams. For a low bridge in which the economic span-length is short, it will generally be the cheapest to omit the cross-girders, except at the bents, and to employ several lines of longitudinal girders. The wider the structure the more likely will this arrangement prove to be economical, and very heavy loads also favor its adoption. For a structure in which the span-length is from one-half to two-thirds of the width, it will usually make little difference which of the two types is adopted, unless the height is rather large; and even in extreme cases the variation between the two is not likely to exceed 10 per cent. Ordinarily it will be found more desirable to use two lines of girders, with cross-girders and cantilevers about 8 or 10 ft. centres.

The proper number of columns per bent depends on the number of longitudinal girders. When there are only two lines, two columns will, of course, be employed. When there are several lines of girders, there should generally be one column per girder in low structures and two columns per bent in higher ones. In this latter case a heavy cross-girder will be required at each bent to carry the longitudinal girders.

The economic span-length is affected by the height and the load, being larger for greater heights and smaller for heavier loads.

Reinforced-concrete piles should be used under footings when a suitable foundation is to be found only at a considerable depth, or when a very large footing area would be required in order to reduce the pressure to a proper amount. A comparison must be made for each case as it arises, allowing properly for the cost of the column shaft, the footing, the piles, and the excavation. This latter item must not be overlooked.

Economy in Arches

In arches the problem is much more complicated than in girder spans. The factors that affect the economic lengths are the cost of the arch ribs and that of the piers and abutments, the dividing lines between them being the verticals through the spring points. For any fixed span-length the greater the rise, up to a limit of nearly one-half of the opening, the smaller will be the costs of both the arch and the piers or abutments which sustain it; but in most cases the distance from grade to ground is too small to permit the adoption of such a large rise; hence the problem generally resolves itself into a determination of the question, "How long can the span be made economically for a certain limit of rise?" This will be influenced by several important considerations, among which may be mentioned the following:

A. The live load used. B. The amount of earth fill, if any, over the arches. C. The depth of the foundations for the piers and abutments below the springing points. D. The cost per cubic yard for putting the bases of piers and abutments down to a satisfactory foundation. E. The necessity for a heavy or substantial appearance of the piers and abutments. F. The height to which the large pier shafts must be carried. G. The condition of the arch barrel—whether solid or ribbed. H. The necessity, or otherwise, of adopting certain span-lengths to meet existing conditions.

Trial and Error Method

Here are too many variables for a theoretically correct economic investigation, hence the surest and most satisfactory way to proceed is to make by judgment the best possible layout consistent with the conditions, then two others, one involving a span-length a certain number of feet greater and the other a span-length the same number of feet less, and figure the costs of arches and piers (or abutments) for all three cases. Instead, though, of increasing and decreasing the span by a certain number of feet, it may be necessary to reduce and augment the number of spans by unity. After the costs of the arches and piers or abutments are found and properly combined, the cost of these two

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portions of the construction per lineal foot of span for each of the three layouts can be computed and compared. The one which gives a minimum will indicate approximately the best span-length to adopt.

In some cases it will prove to be economic to make the middle span of the bridge a certain length and reduce gradually the lengths of the spans at each side. If the configuration of the crossing will permit of a symmetrical layout on this basis, the effect will prove to be pleasing to the eye and generally economic of first cost, especially if a constant ratio of rise to span be maintained; because, as far as cost of substructure is concerned, the overturning moments from live load on a single span only and from inequality of dead load thrusts are kept low, owing to the fact that the lighter thrusts in the smaller span act with a greater lever arm than do the heavier thrusts of the longer span, on account of higher location of the points of springing. In adopting this expedient, though, care has to be exercised to prevent the principles of aesthetics from being violated.

Plate Girders and Riveted Trusses

Comparing rolled I-beam and plate-girder deck spans for modern heavy live loads, the weights of metal are about equal for spans of 15 ft.; but the former are cheaper per pound than the latter by about 0.4 ct., consequently the costs per lineal foot erected are equal to a span of about 20 ft.

Comparing deck plate-girders and through, riveted truss-spans, for which there is usually a difference of about ½ ct. per pound erected in favor of the former, the weights of metal per lineal foot are the same for spans of 115 ft., which is about the extreme limit of length for plate-girder spans shipped in one piece; hence it may be concluded that for all practicable lengths, deck plate-girder spans are more economic than through, riveted truss-spans. Besides, the use of such deck spans effects a great economy in the substructure by reducing the length of each pier from 6 to 10 ft., the longer the span, of course, the less the reduction. It generally reduces also the heights of the piers.

Comparing half-through, plate-girder spans and through, riveted truss-spans, for which there is a difference of about 0.2 ct. per pound erected in favor of the former, the weights of metal per lineal foot are the same for spans of 70 ft., but the costs per foot are about equal for spans of 75 ft. However, as plate-girder spans are in many respects more satisfactory than short, through, riveted spans, the dividing point is generally placed at about 100 ft.

Comparing Pratt and Petit truss-spans, for which there is no difference worth mentioning in the pound prices of the metal, the weights per foot (and therefore the costs) are alike for single-track spans of 300 ft., and for double-track spans of 350 ft.; but both constructive and aesthetic reasons necessitate limiting the lengths of Pratt trusses to about 325 ft.

Economic Requirements of Swing Spans

The economic functions of swing spans are somewhat difficult to formulate. The minimum perpendicular distance between central planes of trusses for first-class construction should be the same as for simple-truss spans—viz., one-twentieth of the span length. It is evident, of course, that the narrower the bridge the less it will weigh and cost. The truss depth at ends of through swing bridges are generally determined by the clearance requirements; but in long spans it is sometimes advisable, for the sake of vertical stiffness and to avoid the raising of span-end from a load on the other arm, to make the said depths still greater. As a rule, this increase is not of an uneconomic nature. For long spans, or those exceeding, say, 400 ft., the truss depth at outer hips should be about one-fourteenth or one-fifteenth of the total span length. The truss depth at the inner hips should generally be from one-ninth to one-tenth of the total span length; and when towers are used, their height should generally be from one-sixth to one-seventh of the span. Of course the aesthetic features of the design should govern greatly the determination of all these depths; and, fortunately, any moderate change in them does not affect materially their economics.

In swing spans it is evident that, as far as is consistent with safety, the diameter of the drum for economy should be made as small as possible, not only because this effects a saving of metal, but also because it reduces the diameter, and therefore the cost, of the pivot pier. For spans of moderate length and width there is generally a small economy in center-bearing swing-spans over rim-bearing ones, especially as the former sometimes permit of smaller pivot piers, but the difference is often inconsiderable. There is a limit to the size of centre-bearing swing-spans due to the objectionable feature of concentrating great loads upon small areas and to the necessity in the case of very wide spans for excessively heavy cross-girders. The question of economics between the two styles of swings is one that has to be determined for each special case as it arises by preparing actual estimates and not by a priori reasoning.

The Problem Applied to Cantilevers

In respect to the economics of cantilever bridges the following may be stated:

The economic length of the suspended span is about three-eighths of the length of the main opening, but a considerable increase or decrease of this proportion does not greatly change the total weight of the metal.

The most economic length of anchor arms, where the total length between centres of anchorages is given, and when the main piers can be placed wherever desired, is one-fifth of the said total length. By keeping the anchor arms short, the top chords may be built of eye-bars, provided that, with the usual allowance for impact, there is no reversion of chord stress; and this effects quite an economy of metal. But it is conceivable that cases might arise where, from danger of washout of falsework, eye-bar top chords would be objectionable; hence this method of economizing must be used with caution.

In respect to the economic length of anchor-span in a succession of cantilever spans, it may be stated that within reasonable limits the shorter such anchor-spans are the greater will be the economy involved; but, generally, navigation interests will prevent their being built as short as might be desired. If permissible, they may be made so short that, as in the case of anchor-arms, eye-bars may be used for the top chords, thus effecting a decided economy of metal, although shortening the anchor-span increases proportionately the stresses on the web members and the weights thereof.

Simple Trusses vs. Cantilevers

The question of what is the economic limit of length of simple-truss spans as compared with cantilevers is still a mooted one. Professors Merriman and Jacoby place it in the neighborhood of 600 ft., but the writer has had occasion to compare simple-truss spans of 700 and 800 ft. with the corresponding cantilever structures, and has found the former more economic. The continuity of cantilever spans in resisting wind loads lowers the requirements for minimum width from one-twentieth to about one-twenty-fifth of the greatest span-length, and hence, because of substructure considerations, gives an advantage to the cantilever type that in certain extreme cases will more than offset its disadvantages of greater weight of truss metal.

There are certain legitimate economies that may be employed in the designing of cantilever bridges, among which may be mentioned the following:

The wind pressure assumed in computing the erection stresses may be taken lower than that given in the specifications for the finished structure, provided that the full wind pressure would not overstress any of the metal seriously or involve any risk of disaster during erection. A stress of three-quarters of the elastic limit of the metal applied a few times during erection would do no harm, and the chance of there being in that limited time any wind pressure at all approaching in magnitude that specified is very small. This lowering of the intensity of wind pressure may be the means of avoiding, in a perfectly legitimate manner, the increasing of the sections of a number of truss members because of erection stresses; but such economizing should be done with caution after a thorough consideration of its greatest possible effects.

Splaying May Save Metal

A certain amount of metal can sometimes be saved by splaying the trusses between the main piers and the ends of the cantilever and anchor arms; but unless the amount thereof be fairly large, the extra pound price of the metal work in the cantilever and anchor-arms due to the sand splaying may more than offset the value of the reduction.

A small economy may sometimes be accomplished by omitting during erection from the cantilever portion of the structure all parts that are not essential to its strengh before the coupling of the cantilever ends is effected, thus reducing the erection stresses a little.

Solitary piers or large pedestals under the main vertical posts are sometimes just as satisfactory in every way as long, continuous piers, especially if a connecting wall of reinforced concrete between them be employed. Generally they will be found to involve a large saving in the cost of the substructure.

Intermediate Trusses for Wide Cantilevers

In very wide cantilever bridges it might sometimes be advisable to adopt intermediate trusses, so as to economize materially in the weight of the floor-beams and a trifle in that of the trusses, also because of the consequent reduction in dead load, but mainly so as to keep within reasonable limits the sizes and weights of the pieces to be handled and thus economize on the size of the traveler and the cost of the erecting machinery. On the other hand, though, increasing the number of trusses is likely to increase a little the percentage of weight of truss details; but where the sections of members are large, this increase would be small. In case the wind stresses are an important factor in the proportioning of the truss members, the employment of an interior truss or interior trusses might, by the reduction in areas of chord sections, cause such relatively large wind stresses on the chords of the exterior trusses that the additional metal required to take care of them would offset all the saving obtained in the ways just mentioned.

In long-span cantilever bridges the stresses on the truss members that rest upon the piers should be divided among as many such members as possible by using an inclined strut on each side as well as a vertical post, instead of carrying all the loads to the top of the latter by tension members, as was done in the design of the ill-fated Quebec bridge. Again, if a lowering of the inner ends of the cantilever arms be permissible, the inclining of the end sections of the bottom chords to the horizontal will take up a portion of the load that is carried to the pier and thus will reduce the stresses on the vertical and inclined posts assembling there. This last feature reduces also the total cost of the masonry by diminishing the height of the main piers, and saves placing the tops of the trusses at an abnormal height above the water.

Pin Joints More Suitable for Cantilever

If there be any choice between the riveted and the pin-connected types of construction for any cantilever bridge, it is generally better to adopt the latter, because, as cantilever bridges are usually employed for long spans only, pin-connected work is the more suitable. Again, it is a little lighter than riveted work, and therefore the dead load on the structure would be somewhat less. On the other hand, the riveted construction is so much more rigid than the pin-connected that it is preferable to adopt it whenever the conditions permit; besides, in the riveted work it is not necessary to stiffen any truss members for erection, although it might be obligatory to increase a few of their sectional areas.

Very large compression members should be made of box section, so as to do away with latticing. This not only effects an improvement in the design, but also saves some metal, although the details required at the panel points to distribute the stresses from the cut cover plates tend to offset the saving in weight of lattice bars and stay plates.

Erection Problems Determine Type

Questions of erection often not only affect the economic layouts of crossings, but also determine the character of the spans to be adopted. For instance, if the danger from washout of falsework be great, either a cantilever or a semi-cantilever structure may be better than one of simple spans, or a pin-connected structure may be preferable to a riveted one, even if the computations of cost made upon the basis of good luck in erection indicate that the contrary is the case. Again, the chance of not getting the substructure finished before high water or bad weather causes a cessation or partial cessation of work might so affect the layout of spans for a bridge as to increase materially the cost thereof; therefore, the expense involved by taking precautions to avoid possible delay would be in the nature of true economy.

In the proportioning of main members of bridges, and even occasionally in the detailing, small economies may be effected by choosing the regular and least expensive sections. Plates and angles are at times cheaper than channels or I-beams, and at other times more expensive. Z-bars are sometimes higher and are always difficult to obtain. Deck beams are invariably high priced, and tees are generally so. Many designers are not aware that I-beams over 15 in. deep cost 0.1 ct. per pound more than those 15 in. and under in depth, and that angles having one or both legs longer than 6 in. are subject to the same increase. There is a long list of special prices, too, on very small angles. Not infrequently it will be cheaper to use the larger of two small angles, even though more weight be involved; and special angles such as those of 7 by 3½ in. section are always more expensive than the standards, besides being more difficult to obtain.

Duplication Reduces Cost

The duplication of a whole structure, or any parts thereof, effects a large proportionate saving in the shop. Of course, if two spans or other units can be made alike, entire groups of drawings are saved; and it is a large part of the function of the detail shop draftsman to duplicate individual parts and to group partially-unlike members. By duplication, in addition to a saving in drawings, there is a saving of templets, a saving of shop supervision, a saving of the writing of shop bills, a saving of making extra material lists, a large saving in errors, and a considerable saving in the field, due to the avoidance of loss of time in the selection of the proper parts; for if there is much duplication, there is much more possibility of the right parts being at hand. Duplication extends into very small details; in beam work the end connections are made alike, and, instead of being shown on the drawings, their numbers only are given. Likewise the templets for such end connections are made permanent; and they, too, are referred to only by number and are used over and over again. On large structures, batten plates, lattice bars, and other similar and oft-repeated elements can be duplicated with great advantage. For instance, identical lattice-bars save the resetting of the gauge on the lattice-bar punch, and also the labor of selecting in assembling the material, besides considerable expense in handling. It may at times require more material to duplicate the parts of a structure, and yet it may result in a net saving in the cost of construction; for, although the metal be ordered by the pound, if the evidence of duplication of shop work is made clear in the drawings submitted to bidders, a lower pound price will be named.

Blacksmith work of any kind is always the most expensive work in a bridge shop, and it should be avoided to the utmost, not only because it is not commonly well done, but also because it costs heavily in the drawing-room, in the templet-room, in the forge shop, and in punching, fitting, and assembling. If forging is essential, it should be done in duplicate as much as possible, so that dies may be made.

Crimping of Angles

There is a small economy or the reverse involved in the crimping of stiffening angles for plate-girders; and the officers of the different bridge shops have widely-varying ideas as to whether it is better or not to crimp them. The economy will depend upon their strength and the amount of offset, for the question involved is whether the cost of crimping the ends does or does not exceed that of furnishing and putting in the filling plates. The cost of the freight on the filling plates is often the determining factor in settling whether it is finally more economic or otherwise to crimp stiffening angles, and this feature of the question should be borne in mind by the designer. This matter of cost of freight and other transportation of metal to bridge site applies to the design of a bridge as a whole as well as to the question of crimping.

There is often a material difference between the lightest possible bridge and the most economic one, not only on account of the reduction of cost of fabrication, but also because of that erection; and the designer, in order to obtain the best possible results for all cases, must be well posted on all the important details of both shop work and field work. He should know almost instinctively what is easy and what is difficult to manufacture and to erect; and especially should he recognize when rivets can and when they cannot be driven by the various kind of apparatus used in shop and field.

When a New Bridge Replaces an Old One

In the design of new bridges to replace old ones, the erection should be given full and thorough consideration, since a large amount of the labor of replacing the old structure under traffic may be saved if the new one have panels of such length as not to interfere with the metalwork of the old bridge. There are many other ways in which advantage may be gained by thoroughly considering the erection at the time the new structure is designed, such, for instance, as the supporting of the old stringers on advantageously located falsework until the new girders can be placed, and the shipping of the plate-girder spans riveted up complete instead of requiring that they be assembled in the field.

In all work of designing, the cost of the materials at the site should be studied very carefully, since local prices will often enable the designer to effect a great saving. Where the work is scattered over a wide field, the matter of cost of materials becomes exceedingly important and often changes the type of the structure. The prices of gravel for concrete work, or of very cheap stone, may affect the type of piers employed. The engineer should know markets even better than the contractor, but commonly he does not, and he will often demand an expensive material where a cheaper one would serve his purpose quite as well. Rough averages of prices per unit in place are very apt to produce flaws in the economy of a design.

There is an economic feature of bridge building that is worthy of special mention, in that it effects a large saving in first cost, maintenance, and repairs, often for a number of years. It is the designing of cantilever brackets to carry in the future wagonways, footwalks, and even street railways, and omitting putting them in until required, but providing all the rivet-holes for the future connections. In such cases, of course, the trusses must be made strong enough to carry the additional live and dead loads, and the counterbracing must be figured for both the future and the immediate dead loads.

Roads in Eastern Canada

That the road from Montreal to Quebec City and the King Edward Highway, from Montreal to Rouse's Point, are unexcelled on the continent is the report of Mr. A. A. Briggs, the advertising manager of the Dunlop Tire and Rubber Goods Company, Toronto, who has just made a lengthy tour of Eastern Canada in the interests of the company. "On the other hand, other roads in the East," states Mr. Briggs, "would give an army tank a good wrestle."

The Sorel shipyard, P.Q., one of the oldest shipbuilding plants in Canada, has been acquired by the Federal Government. It has been under lease to the latter for several years.

Welding cast steel sections together into ships is one of the latest propositions for speeding up shipbuilding. Briefly, the idea is to build a hull in sections, each a casting as large as the conditions will allow, and to weld the castings together electrically by an arc method.

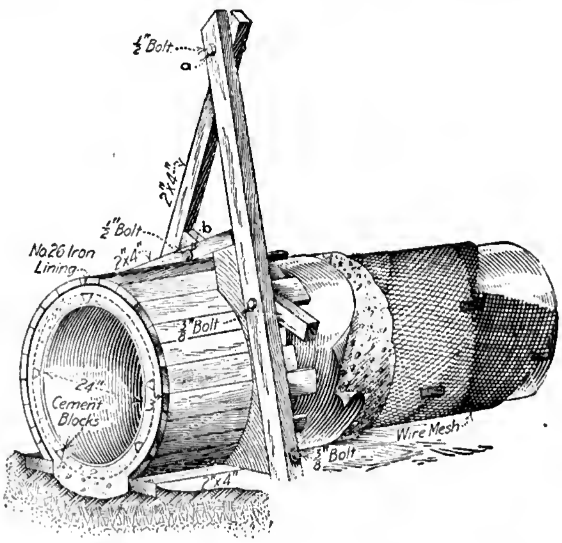
Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Steel Pipe Line Covered with Concrete Without Disturbing Flow

LONG stretches of old riveted-steel water pipe have been successfully encased in reinforced concrete with a economical method in use by the Temescal Water Company, Corona, Cal., for the past four years. In the light of the present high price of steel plates, the work may be of interest to others having pipe lines to replace. The following description is by H. R. Case, in Engineering News-Record:

These details were worked out more particularly for use in covering 10,000 feet of 24-inch riveted-steel pipe line used as inverted siphons working up to 80 ft. head. This line was laid thirty years ago, and is beginning to give way near the end of the siphons, and where light weight steel was used on account of low heads. Possibly 95 per cent. of the iron is still in the pipe, but it has rusted badly and pitted particularly at the seams, so that it has been necessary to make repairs during the irrigation season. The system not only protects the outside of the pipe and prolongs its life by the jacket of reinforced concrete, but eventually utilizes all the iron in the old pipe, and when it has disappeared leaves a reinforced-concrete pipe without joints, sufficiently strong to carry the pressure.



Method of holding forms and concreting steel pipe.

The drawing shows the details of the wood form used in covering the 24-in. pipe. The forms are constructed of Oregon pine and lined with No. 26 black iron, which saves not only the forms, but much material, making a smooth outside surface to the finished pipe. Forms for 24-in. and larger pipe are made in 8-ft. lengths, while the smaller sizes are made up in 12-ft. lengths.

After the steel pipe is uncovered it is thoroughly scraped and cleaned with steel brushes. The ground under the pipe is then shaped to the required depth, the pipe being supported on wood blocks until the forms are set. Bedplates of two by fours are then spaced with a template, similar to the end section of the form, on each side of the pipe, to support the forms when in place. The wire-mesh reinforcement cut to 50 or 75-ft. lengths is then wound spirally around the pipe and supported where the edges unite by small cement-mortar blocks made in the form of truncated pyramids, 1½ in. high, 2 in. square at the base, and ¾ in. at the apex, which is placed next to the pipe. A man with a hand mould will make 2,500 or 3,000 of the small blocks in nine hours. The edges of the mesh rest on the base of the little pyramids, thus keeping the wire mesh spaced a uniform distance from the steel pipe or forms. As the blocks are placed, the edges of the wire mesh are tied together with No. 24 soft stovepipe wire.

The forms are then placed on the two by fours and held rigid by the two ½-in. bolts, as shown. The wood blocks supporting the pipe are removed, and the pipe is held in place by a strand of wire and a turnbuckle clamp until the form is filled to a point where the concrete will support the pipe. The concrete is a 1:2½:1 mixture of cement, sand, and crushed rock or screened gravel of ¾-in. maximum size. It is mixed by hand and poured rather wet, being worked to place with a light rod and by tapping the forms with a hammer. In laying the pipe up hill the top openings, as the forms are filled, are closed with covers clamped to place until the concrete sets slightly, when the covers are removed and the surface is well trowelled and smoothed. The next morning the forms are removed, and the pipe is painted with neat cement. The pipe is then covered with soil and kept wet for two weeks.

Twelve men will easily build and backfill 140 feet of 18-in. pipe, 100 feet of 24-in., or 80 feet of 30-in. pipe in a day of nine hours. The company is replacing 30-in. steel pipe under 40-ft. head, placed on bridges, with concrete siphons of the same size, at a cost of $2.50 per foot, including the ditching, using collapsible inside forms. Covering 24-in. pipe, including the digging, costs $1.70 per foot, and 18-in. pipe $1.40 per foot. Cement is $2.30 per barrel and labor from $2.25 to $2.50 per day. The mesh used is selected from the stock of the United States Steel Products Company, and varies with the size of pipe and head.

Water Ballast Road Roller Provides Varying Pressure

A water ballast roller has been devised by an English manufacturer to provide for rolling roads under varying pressures as required by differing operating conditions. The 12-ton oil tractor is provided with a 4-cylinder, 35-40-h.p. engine, and has a tank roller of sufficient capacity to increase the total weight to 14 tons.

The rear roller is made up of cast iron, and is of heavy reinforced construction, to do its work as a drive wheel. Power is supplied by a moderate speed, water-cooled engine, the radiator being located over the rear roller, where its weight is most useful. Two speeds are provided, viz., one mile and three miles per hour, the speed change being made by control levers located within easy reach of the driver.

H. E. Hilts Becomes Manager of Portland Cement Association

The late J. P. Beck has been succeeded as general manager of the Portland Cement Association by Mr. H. E. Hilts, formerly district engineer of the association at San Francisco. Mr. Hilts has had extensive engineering experience with various railroads and has designed a great many concrete structures. In 1913 he became road engineer of the Portland Cement Association in New England and the Northwestern States, becoming district engineer in San Francisco in 1915. Mr. Hilts is an associate member of the American Society of Civil Engineers, a member of the American Society for Testing Materials, associate member of the American Railway Engineering Association, and a member of the American Concrete Institute.

Costs of Factory Buildings

SOME generalizations covering the cost of factory buildings are published in "Factory." These figures, which may be used in estimating the approximate cost of a proposed building or in appraising the value of an existing one, are as follows:

The cost of manufacturing buildings, with brick walls and wood floor system, including plumbing, heating, lighting, ventilating, and elevator service, but not including sprinkler service, will vary from 5 to 10 cents per cubic foot, depending on the height, the ratio of width to length, and the length. The cost of single-storey, high-roofed mill buildings will vary from 5 cents to 7 cents, depending on the height and the ratio of width to length. For multiple-storey structures the cost will be a minimum for a height of four storeys and a width equal to the length, and will vary from 7 to 15 cents. A good average figure for manufacturing buildings of two or more storeys is 10 cents per cubic foot.

These figures are based upon a floor load of approximately 150 pounds per square foot. As the load increases the cost will naturally increase.

Fireproofing Adds to Cost

Fireproof structures of structural concrete will cost from 5 to 20 per cent. additional; if or structural steel fireproofed with concrete or tile, 20 to 40 per cent. greater.

Wood instead of brick exterior costs less by 10 to 20 per cent.

Steel frame, covered with corrugated iron, costs about the same as wood exterior. Buildings for storage purposes, low and one-storey, are 10 to 50 per cent. cheaper.

Sprinkling will add from 4 to 5 cents a square foot. Heating, lighting, and sprinklers together add from 10 to 15 cents a square foot.

Miscellaneous cost data as follows:

Mill floors, 30 to 35 cents per square foot.

Roofs (tar and gravel), 25 cents per square foot.

Floors, including columns, 35 to 40 cents per square foot.

Structural concrete floors: (a) Cement finished, 40 to 50 cents per square foot; including columns, 50 to 60 cents per square foot. (b) Wood flooring on sleepers laid in cinder concrete, 45 to 50 cents per square foot.

Concrete foundations (not including excavation): (a) Plain, 25 cents per cubic foot. (b) Reinforced, 40 cents per cubic foot.

Walls, 12 to 24 inches: (a) Concrete, 35 cents per cubic foot. (b) Brick, 30 cents per cubic foot. (c) Stone, 20 cents per cubic foot.

Above 24 inches, cost of concrete and brick are about equal.

Cheapest walls are of cement or clay tile, or concrete blocks, from 15 to 20 cents a cubic foot.

Openings, 40 cents a square foot ordinary; 75 cents per square foot in fireproof construction.

Stairways, $100 a flight for fireproof construction.

Plumbing, $75 to $90 a fixture, including piping and partitions.

Incidentals in a building add about 10 per cent.

The cost per square foot of mill buildings, brick walls and wood floor system, including building complete ready for manufacturing equipment, but exclusive of sprinkling, will vary from 75 cents to $2 per square foot of floor area. Sprinkling will add about 4 to 5 cents a square foot. Building alone, without service equipment, except plumbing, about 8 to 10 cents less a square foot. Partitions are extra. These will cost from 15 to 60 cents a square foot of partition. Fireproof windows will add 5 to 10 per cent. to the total cost.

New Book

Petroleum in Canada, by Victor Ross. This is a treatise outlining very largely the history of the petroleum industry so far as Canada is concerned. The petroleum fields in Western Ontario and Western Canada are described, together with the methods put into practice in recovering the product. The chapter headings, as follows, give an indication of the scope of the volume, which is profusely illustrated: Introductory; theories of the origin of petroleum; the petroleum industry in Western Ontario; early history of the Western Ontario oil fields; the drilling and shooting of oil wells; methods of storing and refining; boom days in Alberta; petroleum in Western Canada; petroleum in Eastern Canada; companies, refineries, and individual producers; some products and uses of petroleum; the future of the industry in Canada.

Mainly Constructional

East and West—From Coast to Coast

It is stated that the Alberta Legislature proposes holding a special meeting for the purpose of voting $30,000,000 for use in the construction of highways in the province.

The Romeo Foundry Company, of Port Huron, Mich., propose to establish a $200,000 branch factory in Sarnia, Ont. The engineers are preparing plans and specifications, and work on the new plant is to commence this fall.

Instead of tearing up the roadway and laying a concrete base the city of Sault Ste. Marie has decided to lay asphalt pavement, using the present macadam as a base on Queen Street for a length of about 100 feet as an experiment.

A by-law has been passed by the ratepayers of Walkerville Ont., granting the Sandwich, Windsor, and Amherstburg Street Railway Company the right to build an extension on Ottawa Street, from Walker Road to Lincoln Road.

The eighteen new concrete elevators of the Quaker Oats Company, at Peterboro, Ont., are just about completed.

Rapid progress has been made on this portion of the new plant, day and night work being carried on without interruption.

Hon. R. A. Pyne, Minister of Education for the Province of Ontario, has refused to accede to the request of the Toronto Board of Education that the regulation regarding school sites be amended so far as large cities are concerned, and he declares that large sites must be provided. He also vetoes the erection of new three-storey schools in the city.

The T. Eaton Company are negotiating with the city of Toronto for the purchase of a section of city property for the purpose of erecting a warehouse, at a cost of $65,000. The property desired has a frontage of 400 feet and a depth of 242 feet, and the price offered is $30,000. It is located on the east side of Coxwell Avenue, and was purchased by the city in connection with the Coxwell Avenue subway for $41,703.

On the recommendation of Works Commissioner Harris, the Civic Works Committee of Toronto has decided to abandon the scheme for the extension of Wilton Avenue through to Coxwell Avenue so as to form a new cross-town thoroughfare north of Queen Street. The work was estimated to cost $622,000, and the difficulty of financing it is the chief cause for its abandonment. It may be revived again after the war.

Mr. Frank Pineo, of Malahide, Ont., ex-warden, has been appointed good roads supervisor for the County of Elgin. Deputy-Reeve Todd of Yarmouth, Reeve Hare of Malahide, Reeve Campbell of Dunwich, and Reeve Tolmie of Aldborough have been appointed as commissioners to co-operate with the supervisor in his new duties. The council have placed $5,000 at the disposal of this committee, to be used in the opening work.

The Ladysmith Smelter, near Nanaimo, B.C., is shortly to be enlarged and improved. In the past the copper matte has been shipped to Tacoma, Wash., for refining, but the company operating the smelter have now decided to install converters on their own property. In addition they are planning to greatly increase the plant's capacity. These improvements will cost about $2,000,000, and will, it is said, be started almost immediately.

Mooney and Co. recently began the excavation work for the new filtration plant at Woodstock, N.B., and repairs to the pumping station. The engineer in charge is A. K. Grimmer, of St. Andrew's. The contract for the filtration plant, which will cost $64,948, is in the hands of the New York Continental Jewel Filtration Company, of New York City, and the repairs to the pumping station, which will cost $25,000, are being carried out by Fraser & Chalmers of Canada, Ltd., 285 Beaver Hall Hill, Montreal.

Work is progressing rapidly in connection with the North Toronto improvement of the C.P.R. Wells & Gray, the contractors for the bridge at the Reservoir ravine, are now well forward with the moulding of the reinforced concrete blocks for this structure. These will be placed in position on the concrete towers, footings for which are already laid at the bridge site, by means of special cranes. The old steel bridges in the Belt Line and Reservoir ravines are being dismantled, and traffic is now being carried by temporary wooden trestles.

It is stated that the Board of Works Committee of Chatham, Ont., contemplate taking steps to obtain alligators to assist in the cleaning out of the city sewers. Alligators have been used for this purpose in various United States cities, and, as difficulty is being met with in cleaning many of Chatham's sewers, it is thought that these animals might help to solve the problem. They accomplish the work of stirring up the sediment and refuse in the sewer, thus making it easy to flush out. One plan which has been adopted is to have them draw chains through the sewer.

Fifty per cent. more pavement, concrete sidewalk, and curb and gutter in the city of Regina, Sask., is being repaired this year than in any previous year in the city's history, according to a statement recently made by officials. In addition to repairs which are being made by the city itself, contractors, in the final year of their guarantee, are working on $700,000 worth of paving, sidewalks, and curb and gutters. It is stated that repairs to wood block paving have caused some difficulty ever since construction. This is due to the expansion of the blocks after rains, forcing the adjoining blocks out of place and causing the pavement to heave.

It is reported that the Wallace Sandstone Quarries, Ltd., is to be financially reorganized, and a meeting of the bondholders is called for Nov. 12, in Montreal. Some weeks ago the company defaulted on its half-yearly bond interest due June 1, and a proposition is now to be made to the bondholders to release their prior claims and accept an equal amount of 7 per cent. cumulative preferred stock. The bonds, which are of the thirty-year 6 per cent. sinking fund class, were issued in 1912 to the amount of $800,000 out of a total authorized amount of $1,000,000. The company owns quarries of building stone in Nova Scotia and Manitoba, but the slackness in the building trade caused by war conditions seriously interfered with their profitable operation.

War conditions have caused a large demand for men with engineering education and ability. To cope with this situation it has been decided by the Faculty of Applied Science of Queen's University, Kingston, that it is advisable, during the period of the war, to admit students with a lower requirement in mathematics, namely, pass matriculation. During the last two years, as well as pass matriculation, pass standing on the honor matriculation papers in mathematics has been required. The deficiency will be made up in the first year by devoting a larger amount of time to mathematics, so that the total requirements for a degree will remain exactly the same. By this measure the university makes it possible for young men to begin their engineering education a year earlier.

The ratepayers of Sault Ste. Marie, Ont., and Steelton, Ont., have passed a by-law approving the amalgamation of these two municipalities as one city. The union will take effect in about five weeks, with the result that Sault Ste. Marie will have its population enlarged from 13,000 to over 20,000, while the town of Steelton will disappear from the map. All the town officials at present employed by Steelton will, by the terms of the agreement, be taken on the city staff. Both municipalities have a considerable area of paved streets, and the union is looked upon as another step towards making the Soo a big industrial centre for Northern Ontario. The area now known as Steelton will have four representatives on the City Council, and the present city of Sault Ste. Marie will have eight.

Personals

Mr. Ernest Drinkwater, St. Lambert, P.Q., has been elected an associate member of the American Society of Civil Engineers.

Mr. Noylan Cauchon, consulting engineer, of Ottawa, has been invited by Mr. Thomas H. Mawson, the noted English town-planner, to co-operate with him in the re-planning of Salonika. The commission for this work was recently awarded to Mr. Mawson by Premier Venizelos. Salonika is now the base for the Allied army of over a million men operating in Macedonia.

Obituary

Mr. George Morgan, mayor of Blenheim, Ont., died recently at his home in that city, at the age of 78. Mr. Morgan was one of the best-known contractors in Western Ontario, where he carried out a considerable quantity of construction work.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Blenheim, Ont.
The Town Council will construct concrete walks on Hall and John Streets. Clerk, P. Shillington.

Cardston, Alta.
Town Council contemplate improvements to waterworks system. Mayor, W. E. Pitcher.

Dutton, Ont.
Tenders will be called about November 1 for the construction of cement walks and curbs on Main and Shackleton Sts. for the Town Council. Clerk, J. D. Blue.

Guelph, Ont.
City Council contemplates construction of sewers from Edinburgh Road to Meadowview Ave. Engineer, E. McArthur.

Hamilton, Ont.
Tenders will be called by the Mayor, Chas. G. Booker, about October 5 for the construction of a sewer on Dunsmore Road from Ottawa Street to London Street for the City Council.

London, Ont.
City Council contemplate construction of storm sewers. Engineer, H. A. Brazier.

Mimico, Ont.
Tenders received by the clerk, J. A. Telfer, until noon, October 8, for the construction of sanitary sewers for the Town Council. Plans and specifications with the engineer, T. Lowes, Library Bldg.

Renfrew, Ont.
Waterworks Department, Town Council, contemplate the construction of a sewer on Opeongo St. Engineer J. R. Stewart, will purchase 300 lineal feet of six-inch vitrified sewer pipe.

Sarnia, Ont.
City Council contemplate erection of a disposal plant. Engineer, John A. Baird.

Town Council contemplate construction of a sewer on Capel Street from Maxwell to Nelson Streets. Engineer, Jas. Baird.

St. Marys, Ont.
Water Commission, Town Council, will purchase a waterworks pump. Mayor, Wm. Weis.

Sydney, N.S.
The City Council contemplate construction of water main and sewer on Newbury Street. Engineer, Norman K. Hay.

Weston, Ont.
Tenders received by the Water, Power & Light Commission until 5 p.m., October 8, for the construction of a watermain on Little Ave. Plans and specifications with the engineers, James, Loudon & Hertzberg Ltd., Excelsior Life Bldg., Toronto.

CONTRACTS AWARDED

Berthierville, Que.
The Kennedy Construction Co., Ltd., 137 McGill St., Montreal, have the general contract for macadamizing road 20 feet wide and 5,000 feet long for the Municipal Council.

Ottawa, Ont.
O'Leary's Ltd., Bank National Bldg., Ottawa, have the general contract for pavement costing $8,000 for the Canadian Pacific Railway, Broad St. Station, head office, Montreal.

Ridgetown, Ont.
Geo. Poag, Jane St., and Geo. Farnsworth, Tiffany St., have the contract for cement walk and crossing for the Town Council.

Trail, B.C.
Victor Bianco has the contract for 1,950 foot vitrified pipe line from Cambridge Creek to Violin Lake, also five miles of steel mains throughout the Municipality for the City Council.

Railroads, Bridges and Wharves

New Brunswick, Province of
Tenders are in for the erection of a 174-foot wooden Howe truss bridge with concrete wall abutments for the Department of Public Works, Provincial Government. Minister, P. J. Veniot.

Somerset South Township, Que.
The Dominion Bridge Co., 285 Beaver Hall Hill, Montreal, have the steel contract for $5,000 concrete and steel bridge for the Municipal Council. Substructure by day labor.

Public Buildings, Churches and Schools

Halifax, N.S.
Tenders being received by the Children's Hospital Commission until October 6 for the erection of a tile and brick addition. Plans with the Commission and architects, Stephens & Lee, 2 College St., Toronto.

Humboldt, Sask.
The erection of a $4,000 laundry for hospital is contemplated by the Sisters of St. Elizabeth.

New Glasgow, N.S.
The Trustees of Aberdeen Hospital are still receiving tenders for the erection of a nurses' home. Separate contracts will be let for plumbing, heating and electrical work.

St. Bonaventure, Que.
Plans and specifications with the architect, P. Levesque, 115 St. John Street, Quebec, who will receive tenders in the near future for alterations to church for the Parish.

South Osgoode, Ont.
Plans and specifications with the architects, Millson & Burgess, Union Bank Bldg., Ottawa, who will receive tenders until October 6 for the erection of a $15,000 church for St. Johns Congregation.

Taylorville, Alta.
The Latter Day Saints Congregation contemplate the erection of a church. Address, M. A. Lowry, Alex. Anderson and F. Sommerfeldt.

Toronto, Ont.
Brig. G. Miller, care of owners, has drawn plans for a $7,000 addition to hall at Keele and Dundas for the Salvation Army, Albert Street.

Christ Church, Lawton and Yonge Sts., contemplate the erection of a small mission building on Manor Road. Vicar, Rev. H. A. Brooks, 29 Alvin Ave.

Winnipeg, Man.
The Military Hospitals Commission, Ottawa, contemplate the erection of a recreation building. Director, S. A. Armstrong.

Canora, Sask.
Hanks & Bertram have the contract for basement for $12,000, one-storey, frame Greek church for the Greek Congregation.

Halifax, N.S.
Walsh Bros., Ltd., Hollis St., have the painting, and Farquhar Bros., Barrington St., the metal work for $12,000 storehouse building for Department of the Navy, Dominion Government.

London, Ont.
Sam Willis, 765 Talbot St., has the general contract for $7,000 vocational training school for the Government Hospital Commission.

Maisonneuve, Que.
Colas & Charests, 598 St. Lawrence Blvd., have the painting, and Lepage Marble Works Ltd., 734 St. Lawrence Blvd., the tiling for $200,000 school for the Roman Catholic School Commissioners, 87 St. Catherine St., who are receiving tenders for blackboards and seating.

Marieville, Que.
Jos. Lefebure, 2171 St. Denis Street, Montreal, has the plastering, and T. X. Renaud, 2312 Esplanade Ave., Montreal, the painting contract for $150,000 church and presbytery.

Montreal, Que.
Fussing & Jargensen, 6 Durocher St., have the general contract for renovating church for the Temple Baptist Church. Architect, Sydney Comber, Drummond Bldg.

The following contracts have been awarded in connection with the erection of a $115,000, three-storey, reinforced concrete and brick school for the Roman Catholic School Commissioners, 87 St. Catherine W.:—Brick, Jos. Frenette, 324 Breboeuf St.; concrete, Levasseur & Leduc, 390-11th Ave., Rosemount; ornamental iron, Montreal Architectural Iron Works, Ltd., 157 Prince St.; roofing, plumbing and heating, T. Latourelle &

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Principal Contents

Efficiency or Mob Rule

THE strike of street cleaners in Toronto during the past week, if it has served any purpose at all, has demonstrated once more the unreasonableness of mob rule. Efficient civic departmental administration—be it ever so efficient—is frequently called upon to cope with disgruntled and badly informed subordinates. The more capable a civic administration, the greater the resentment, apparently, from those employees of the department who, through perverseness or ignorance, mistake a proper application of authority for undue dictation or a curtailment of personal liberties.

Public opinion in Toronto is justly against the striking street cleaners and garbage men. Without notice and under a libellous pretext, they are tying up the operation of an essential department, purely to wreak vengeance of an absolutely personal character on the head of this department. Their demands for the removal of Commissioner Wilson are neither backed by righteous reasons nor commendable purpose. In calling for his suspension, they are being marked, in the minds of the right thinking public, as anarchists against capable authority and worthy administration. Fake grievances, unsubstantiated by fact, form the basis of their attack. The employees play upon a trivial incident and magnify it to proportions of treasonous lack of patriotism on the part of the commissioner. Mr. Wilson's love of the Empire is vouched for by personal sacrifice and by his departmental regulations and enactments that aim to keep the priority of the war uppermost. Under the guise of patriots, his employees are scoring a man whose only sin has been capable and worthy management.

The system of street cleaning and garbage collection in Toronto has reflected credit on the head of the street cleaning department, his staff and employees. True, war time has imposed its difficulties, so far especially as the labor supply is concerned, but the condition of Toronto's streets and the maintenance of its garbage collection are scarcely excelled in a city of like size. The administration of the department has been co-ordinated and the efficiency of its system increased until it has developed into one of the best operated departments in the city hall. For the employees to strike against firm but efficient rule, that is without parallel so far as freedom to subordinates is concerned, is a candid admission of their inability to appreciate good working conditions.

That the civic employees have been badly guided by their leaders is apparent. The evidence seems to indicate that the whole situation is a result of the intrusion of petty politics into civic affairs. Toronto has been fairly free from the underhand workings of the ward politician, but suspicion, in this instance, seems to rest on the ambitious schemes of some who have no right to meddle in civic matters. A situation like this calls for prompt and decided action. So soon as ward politics begin to govern civic management, just so soon may we expect to lose self-respecting, wholesome, upright government. Commissioner Wilson stands for the ideals of worthy management. Toronto must not go to the depths of many sister cities, whereby no self-respecting citizen can afford to serve his municipality without becoming thereby associated with the grafters and the politicians. Toronto must rise up with a stern hand to quell the inroads of the mob flushed with promises of "easy jobs" and grafted money. The city council must do its share to allay what bespeaks a wolf in sheep's clothing.

Question of Deposit Cheques with Tenders

THE question of the deposit of certified cheques with tenders was discussed at the last monthly meeting of the directors of the Montreal Builders' Exchange. It came before the Exchange in the form of a communication from a member, who wrote: "A number of city contractors were recently invited to tender for a large building in the Island of Montreal. The specifications required each tenderer to deposit an accepted cheque for 10 per cent. of the amount of his tender with the stipulation that the cheque of the successful contractor should remain in the hands of the owners until thirty days after the completion of the work. It was also provided in the specifications that payment should be made as the work progressed on the basis of 80 per cent. of the value of the work done, and that the balance of 20 per cent. should remain until thirty days after the completion of the building. This means in effect, that the owners are obliging the contractor to finance the erection of the building to the extent of 30 per cent. of its value. As this would amount, in the case of a $200,000 job, to about $60,000, it can readily be seen that it might work great hardship to the contractor. In any event this is a practice that members of the Exchange should not encourage. Although there is much to be said in favor of the method of asking for accepted cheques on the part of governments, municipalities, and other public bodies, the members of the Exchange should insist that in ordinary cases they should not be obliged to deposit money with private companies and owners without asking for satisfactory guarantees to protect their interests and to provide for prompt payment of the owner's obligation. Only by getting together can contractors impress on the public the necessity of making specifications and contracts that shall be fair to both parties and not sacrifice the dignity of the contractor or weaken his position as compared with that of the other party to the contract."

It was decided to refer the question of large deposits accompanying tenders to the committee appointed to discuss with the Architects' Association of Quebec, matters of common interest.

Mr. J. P. Anglin, the president, referred to the large number of French Canadian contractors who are not members of the Exchange, thus diminishing to some extent the usefulness and influence of the Exchange, when dealing with such questions as contractors' costs (still under the consideration of the general contractors' section) and labor trouble. Attention was also drawn to the inequalities in the rate of wages paid to various trades in different parts of the city.

The secretary was instructed to prepare a list of the larger French Canadian firms who are not members of the Exchange and submit it to the membership committee for consideration.

Dispute Between Builders and Architects

Mr. J. Quinlan referred to the many petty disputes and misunderstandings that arose in the course of their business between architects and themselves and which were the source of needless expense. The Board of Arbitration and Valuation, he said, was performing a useful service in settling by arbitration business matters in dispute between members, and he suggested that a joint committee of arbitration composed of men of the highest standing in both professions should serve the same useful purpose. He moved that a committee of the Exchange be appointed to discuss with the Architects' Association matters of common interest, and also take up with the latter the question of joint action regarding arbitration. This was agreed to.

It was decided to continue the fortnightly luncheons.

Planning to Reduce Building Cost

WITH the object of formulating plans to reduce the cost of building, a meeting of general contractors and dealers in builders' supplies has been held at the Builders' Exchange, Montreal, under the presidency of Mr. J. P. Anglin. Due to war conditions, the cost of building is very high, which naturally has a tendency to restrict operations. The demand for houses and apartments is unusually keen, but there is no inducement to meet this want in view of the heavy outlay involved. The object of the conference was to devise some method to lower the cost and to submit this to a general meeting of the Exchange. During the discussion reference was made to plans adopted in various United States cities and also to plans under consideration by the Toronto Builders' Exchange. It was decided to hold a special meeting of the general and brick contractors on the 11th inst., to further discuss the subject.

Steel Situation Uncertain

THE steel situation as it affects Canadian industries is still uncertain. Canada's big steel plants can, of course, supply a great portion of the country's needs, but there is still an absolute dependence upon the United States market for certain shapes, particularly those required for the shipbuilding industry. The embargo which has been placed upon these, therefore, may cause a stoppage of a great deal of important work, unless the Dominion authorities take steps to relieve the situation and safeguard the interests of many Canadian firms affected. These conditions are naturally the cause of considerable alarm, and the steel men are busy estimating their requirements, in order to place them with the Department of Trade and Commerce at Ottawa. It is hoped that relief may be obtained by this means, although the matter rests very largely with the United States Priority Board.

The Canadian public in general have been under the mistaken impression that the cut in iron and steel prices by the Washington authorities should mean a reduction in the prices of steel products in Canada. This, however, is not the case, as the order enforcing the lower prices in the States does not extend to the export trade, but only affects United States and allied war contractors and those engaged in the United States domestic trade.

X-Rays Detect Deficiencies In Concrete

RECENT experiments have shown that reinforced concrete can be examined by X-rays, so as to give a very clear indication of its internal structure and to show the condition of the ironwork after a considerable time, such as a number of years, when the concrete may require to be examined for any possible deteriorations. The experimenter made use of reinforced concrete slabs of a few inches thickness and containing ¼ inch round iron. The resulting photographs clearly showed the position and arrangement of the iron and the joints, and even the structure of the concrete itself was brought out. Then he made another series of tests in order to show up any cracks in the concrete, and this is of great value in practice, because such cracks will admit air or moisture to the iron parts on the inside and cause them to rust. He treats the plate by injections of a bismuth salt or powder in suspension, which is well known to be opaque to X-rays, the solution being applied under pressure, so as to fill up all the cracks with the bismuth preparation. In this way he was very successful in locating even the finest cracks, such as will cause the entry of air to the metal.

The Emergency Fleet Corporation, which has charge of building the great merchant marine fleet for the United States Government, is letting contracts for three government-owned shipyards to cost, it is said, $35,000,000.

La Loutre and Lake St. Francois Dams

Report of Quebec Streams Commission Details Progress and General Construction Methods on Water Storage Projects

IN its fifth annual report, just published, the Quebec Streams Commission describes the work accomplished during the past year on its various projects. The most important of these is La Loutre dam, on the St. Maurice River, which is to serve to regulate the flow. Other works being carried out under the supervision of the Streams Commission include a storage dam on Lake St. Francois, which necessitated the building of a large steel bridge crossing the River Sauvage; investigations into the storage possibilities of Lake Des Commissaires, River St. Anne, Great Lake Jacques Cartier, and Lake Kenogami; also gaugings of the Chaudiere, Bell, Harricana, and L'Assomption rivers. From the report dealing with these undertakings the following matter has been abstracted:

Tenders were called for the La Loutre dam, on the St. Maurice River, in May, 1915, and the contract awarded in July of the same year to the St Maurice Construction Company, Ltd. The contractors started operations immediately.

Materials Delivered by Scows

The route followed for the transportation of materials is the valley of the River St. Maurice from Manouan to La Loutre.

The freight is brought up by railroad to Sanmaur, a station put up by the contractors and located one mile east of Manouan, on the Transcontinental. At Sanmaur a number of sidings have been built, and the freight is brought up to a wharf. From Sanmaur to Chaudiere the freight is carried on scows, which are towed by steam and gasoline boats. During high water the river is navigable on this whole distance of 32 miles for boats drawing nine feet of water, but at low water navigation is limited to boats drawing two feet for the first ten miles from Sanmaur to Nine Miles Rapid. Here a wing dam was built so as to concentrate the flow of the river in the east channel. The contractors had to do quite a lot of work to clean the river of boulders which made navigation dangerous.

The freight carried is made up of provisions, plant, structural and reinforcing steel and, chiefly, cement.

Oil Burning Locomotives

The scows cannot be towed further up than a quarter of a mile below Chaudiere Falls, where a wharf has been built and a guy-derrick is used to transfer the freight from the scows directly on the cars. From this wharf to the dam the contractors have built a standard railroad, which follows the west side of the river for a distance of 20 miles. It is made of 56-lb. rails, laid on ties 8 inches thick. There is no grade exceeding 3.5 per cent., and the maximum curves are 12 degrees. The trains are hauled by oil-burning locomotives, thereby eliminating the chances of forest fires. The creeks and the Cypress River are crossed over trestles built as those of the permanent railroads. The distance of 20 miles is covered in less than two hours by a locomotive hauling two loaded cars. The railroad has been in operation since the middle of August, 1916.

During the winter of 1916 the contractors had a great number of logs—(about 3,200,000 feet B.M.) cut in the vicinity of the dam site. All this timber was hauled to the river and there held by booms.

During the fall of 1915 it was not possible to haul enough provisions for the winter supply. The contractors had to transport during the winter by means of teams and sleighs. The large amount of snow which fell during the winter made this work very costly, but it was possible to haul the food required, as well as the machinery for the hydro-electric plant at La Loutre Falls and the sawmill.

Hydro-Electric Development

After a consideration of the cost of fuel delivered at La Loutre, the contractors decided that it would be profitable to operate all their machines by motors and compressed air. They, therefore, harnessed part of the falls at La Loutre and installed two turbines, having a capacity of 1,100 h.p., under a head of 15 feet. The power-house is located on the east side of the river, about two miles from the storage dam site. The power dam consists of wooden cribwork, with proper spillway and log sluice. The machinery in the power-house is set on concrete. During low water it was found necessary to build a dam across the west channel of the river, so that most of the discharge would take place through the head race of the power-house.

As mentioned above, the power-house has a capacity of 1,100 h.p. The electricity is transmitted to the storage dam over a wire line two miles long. Electricity is used to operate most of the machines, air compressor, sawmill, concrete mixers, crushers, pumps, etc. Moreover, most of the buildings around the dam site are lighted by electricity.

To house its staff the contractors had to build on the west side of the river a great number of buildings. An area of 54 acres of land was cleared for that purpose; a water system was installed in most of the buildings. The water is pumped from the river above the dam site and distributed through proper piping.

Cement Carefully Tested

The cement is shipped from Montreal by the Canada Cement Company. Its inspection is made at the shipping point by the Canadian Inspection and Testing Laboratories, Ltd., and the material shipped only after satisfactory tests as to fineness, setting, specific gravity, boiling, and a neat test of 150 pounds at 24 hours. The testing company also makes tests at seven days and twenty-eight days.

At Montreal twenty samples are taken from each carload. These twenty samples are well mixed, and a single test is made with the mixture, which represents the average quality of the cement in the car.

We have also established at La Loutre a testing laboratory, where the cement is tested thoroughly before being used.

The contractors have devised, for the transportation of cement from Sanmaur to the dam site, a system which has proved very economical. When the cement reaches Sanmaur it is placed in specially-built boxes or skip-pans, each having a capacity of 76 bags, and a derrick lifts these boxes from the car into the scows. When these scows reach Chaudiere each box is lifted by a derrick and placed upon a flat car, which is hauled to the dam, where the skip-pans are emptied into a large shed built especially for the storage of cement

Sand Obtained Near Site

The contractors have found, close to Cypres Rapid and along their railroad, about five and a half miles from the dam, a large sand-pit. Samples of the sand were taken at different points in the pit and sent to Montreal for testing purposes. The tests made by the Canadian Inspection and Testing Laboratories, Ltd., were satisfactory. The contractors were then authorized to use this sand for the concrete. They have placed at the pit a steam shovel, which loads the sand into side dump-cars, hauled to the dam site by locomotives.

A quarry has been opened on the slope of the mountain on the west side of the river, and the stone for the concrete is hauled from that point. The stone is passed through a series of crushers until it is broken to the size required by the specifications.

A large quantity of reinforcing steel has been delivered at the dam site. The structural steel for the gates and the racks has also been delivered. This latter material has been inspected by the Dominion Engineering and Inspection Company. The gates are assembled at the shop in Montreal and thus shipped to the works.

Construction Methods

The construction of the dam was started on the east shore of the river, which was unwatered early in the summer of 1916. The excavation was completed to the solid rock over all this part of the river—that is, a distance of about 200 feet. Conditions found have verified what the borings of 1913 indicated, except for a certain part on the east side of the island, where it was found necessary to remove the surface rock to a depth of a few feet, owing to its being considered unsuitable to resist the weight of the dam.

On November 1 there were in place 5,700 cubic yards of 1:2½:5 concrete, into which was imbedded an average of 29.5 per cent. of boulders. Instructions were given that in the concrete mixture one bag of cement weighing 87.5 pounds shall be taken as representing 86 per cent. of a cubic foot. The proportions are arranged so that for six bags of cement there are used 13 cubic feet of sand and 26 cubic feet of crushed stone. For the stone the run of the crusher is used, but measurements are taken of the screenings and the quantity of sand is reduced accordingly. The concrete made to date appears to be of very good quality.

The dam is built by sections 40 feet long. These sections are joined together by vertical notches five inches deep and three feet wide.

Cribs Enclose Site

Considerable work has been done preparatory to the unwatering of the river in the west channel, which is by far the most important. Wooden cribs have been sunk and completely filled with stone. These cribs will have the resistance of dams. The upstream cofferdam is built up to Elevation 1,300 feet, making it possible to store a considerable amount of water above the site.

The telephone line was built on the western side of the river. Communication can now be had between Sanmaur, Nine-Mile Falls, Chaudiere, La Loutre Falls power-house, and the dam site—the commission's and the contractors' offices.

The work of construction at La Loutre is under the charge of Engineer J. B. D'Aeth, who has a staff required for proper inspection.

Lake St. Francois Storage Project

The controlling works necessitating the construction of a storage dam at the outlet of Lake St. Francois—a contract for which has been awarded in September, 1915, to Mr. George Madden, of Quebec—are mentioned below:

Construction work was started in the fall of 1915. The contractor completed then most of the excavation located above the high water on each side of the river. He also filled up with concrete three of the five test pits made to allow an examination of the nature of the foundation.

During the winter construction was stopped, but a large amount of building material—sand, stone, and timber—were hauled to the site.

The work was resumed early in the month of May, 1916. Only one change had to be made in the contract plans. These called for the cut-off walls to be ten feet deep below the bottom of the floor and three feet wide throughout. It was found rather difficult to excavate trenches three feet wide and having vertical walls. The cross-section of the cut-off walls was built four feet wide immediately below the floor and two feet wide at its base, ten feet lower. The cross-section has the same area as the original section, and its construction is much easier while giving the same efficiency against percolation.

Stone and Sand

The stone was hauled from surrounding fields and delivered at the dam site and paid at so much per ton. It was crushed whenever required for concrete.

About one mile from the dam site a good sand pit was found close to the shore of the lake. Several samples taken from different parts of the pit were sent to the Canadian Inspection and Testing Laboratories, Ltd., in Montreal, to be tested. Every sample gave satisfactory results. The mechanical analysis indicated that the sand contained a maximum of 30 per cent. of stone of one-quarter of an inch and over.

Log Slide

The original plans called for a steel log slide, which could be lowered or raised as the level of the water in the reservoir would fluctuate. The parties interested in the driving of logs at the outlet of the lake claimed that the volume of water which would run through the slide would not be sufficient to float the logs downstream. They required that all of the water which had to be discharged through the dam be discharged by the log slide during the period of the timber drive.

Their request was granted, and a permanent slide, built of concrete, was designed so as to receive the water supplied by the opening seven feet wide and twelve feet deep. Of course, while sluicing logs, the three bottom sluices shall be closed. In this way it is expected that the velocity of the water shall be such that the logs will be drawn to the sluice's entrance.

The substitution of the concrete slide for the moveable steel slide decreases the cost of the dam somewhat.

Precautions Taken in Winter

For winter work all the necessary steps were taken to protect the concrete against frost—the water was heated to 150 degrees Fahrenheit, the sand was stored in a chamber heated by steam; the crushed stone was also heated by steam, and the forms for the concrete were made two inches thick, of grooved planking. These forms were closed and the interior heated. The concrete mixer, the sand and the stone were properly sheltered.

The building of the dam at the outlet of Lake St. Francois, which will raise the water fifteen feet, necessitated the construction of a new bridge across the River Sauvage. This new bridge is located about 400 feet upsteam from the present structure.

Tenders were called for two schemes—a wooden bridge and a steel bridge over masonry piers. The contract was awarded to Galbraith & Cate, Ltd., of Montreal, for a steel structure.

The work was started immediately, and in September, 1916, the contractors had completed the two abutments and the approach fills. As to the construction of the piers in the river itself much trouble was experienced, owing largely to the extraordinary high water in Lake St. Francois.

The Fight Against the Fire Hazard

Prominent Authority Offers Suggestions to Reduce the $230,000,000 Annual Fire Loss on this Continent

THE fire loss in the United States and Canada for the last ten years has averaged $230,000,000 a year. This waste touches the pocket of every man, woman, and child in the nation, and strikes as surely, but as quietly, as indirect taxation. The profligate burning every year of $230,000,000 is impoverishing the people of this continent, because we all have to pay for one another's losses, indirectly though it may be. There is but one way in which we can escape this, and that is for us to begin rational building construction and protect what we have built against fire. In an address before the Portland Cement Association, Franklin H. Wentworth, secretary of the National Fire Protective Association, emphasized this point and offered suggestions to pursue in confronting the fire hazard. An abstract of his address follows:

Sectioning the City

There is a way to solve this conflagration problem —not absolutely, but at least relatively. We cannot be expected to tear down our cities and rebuild them of fire-resisting material; the cities must be protected as they stand. In the heart of nearly every city there are streets crossing at right angles, along which for a very considerable distance are buildings of brick, stone, and concrete. This shows a more or less complete Maltese cross of buildings which are not wood and which operate to divide the wooden-built district into quarter-sections, and which might hold a fire in any one of these sections if they were equipped to do so. These brick and stone buildings are ordinarily valueless as fire-stops, because their windows are of thin glass and their window frames of wood. At Baltimore and San Francisco the conflagration attacked such buildings easily, breaking out the panes, consuming the frames, and converting every story of these brick structures into horizontal flues full of combustible contents. Brick and stone buildings are logical and capable firestops if the fire can be kept out of them. The small city that will trace out its Maltese cross of such buildings and equip them with metal window frames and wired glass will immediately possess the equivalent of substantial fire walls crossing at right angles in its centre, dividing it into four sections. By such a simple, inexpensive, but yet strategic procedure, many a city may save itself from the destruction which now awaits only the right kind of a fire on the right kind of a night.

I have referred in this plan merely to the smaller cities, but it is obvious that this form of protection is equally imperative in the brick, stone, and concrete districts of all large cities where great values are housed in close proximity. Fires in the large cities entail an enormous waste because of the great values assembled there. We must come eventually to the equipment of all commercial, factory, and office buildings with metal window frames and wired glass. This will mean the abolition of the conflagration hazard in our cities. Fires will then be unit fires, extinguished easily by a competent fire department within the building in which they originate; for the protection of window openings not only prevents fire from entering, but prevents fire from issuing out of the burning building. We may expect an occasional exceedingly hot fire to break down the defence of an adjoining building, but it is obvious that a conflagration could not get under way among buildings of fire-resistive construction with properly-protected window openings.

Automatic Sprinklers Eliminate Hazard

Having thus fortified city buildings one against the other, extensive fires within individual structures can be prevented by the use of the now well-established automatic sprinkler system. The automatic sprinkler appiles the water without the help of human agencies while the fire is still incipient. It will operate in a dense smoke as well as in a clear atmosphere. It will not throw excessive deluges of water in wrong places as the fire departments are continually forced to do. With our window openings protected and our buildings equipped with such extinguishers, the conflagration hazard in mercantile districts will be eliminated. There will then remain for consideration our immense residence districts. We can lessen the loss here by the abolition of the use of wooden shingles.

The prohibition of the wooden shingle roof, which is now generally recognized as a conflagration breeder, is to-day almost universal within city fire limits, and from the more enlightened communities it is excluded altogether. Burning shingles can be carried great distances by the wind or draft of a conflagration, and when they alight in their turn upon other shingles, they make fearful havoc.

Replacing Shingle Roofs

It will not be necessary to remove all shingle roofs immediately. An effective city ordinance might require all roofs constructed in the future to be of incombustible material, and that all roofs which shall hereafter require repair to the extent of one-third of their area shall be replaced with incombustible roofs. The modern shingle is thin, and the machinery which now makes it leaves a fuzzy surface, which, after a period of drought, becomes like tinder. Without shingle roofs, flying brands would not be carried over the brick centers of the city by the wind.

Outside of the abolition of the shingle roof, we must look for the protection of our homes to the corrected habits of our people. We must look carefully after the heating apparatus of our homes, giving them the constant and necessary attention demanded by receptacles containing fire. The building of proper flues and chimneys is especially necessary in connection with residences. Then we must have a general revision throughout the country of our building codes. We must stop the building of a certain shoddy class of buildings and we must limit the height of all buildings. There is no reason why cities that can expand, and which are not bound by physical barriers, should follow the example of New York and erect absurdly high buildings. They inflict an enormous expense upon the city for fire protection.

There are other matters, however, to which we must give proper thought. Among them is the best use of the fire-fighting agencies which have been established and which are maintained at a great cost by our people.

Firemen as Inspectors

The mental habits of a people are a vital factor in affecting social progress. It is the mental habit of our people to assume that fire departments are maintained for the exclusive purpose of extinguishing fires. It is obvious, however, that fire departments have large possibilities for service in preventing fires; a service which is, I regret to say, yet largely potential. In every fire department uniformed firemen should be regularly detailed for inspection service. Three or four hours a week for each man, going into basements, attics, courts, and alleys, keeping down accumulations of rubbish—which spring up over night—locating the storage of inflammable oils and explosives, would keep the city clean of its most persistent fire dangers. Every fireman should, in turn, cover every section in the course of six months. One would thus check up the inspections of the other, and local conditions would become a matter for educative conversation about headquarters.

There is, however, a most important result to be achieved by such an inspection system over and beyond keeping the city clean; and that is the education of the fire-fighters in the exact physical character of the city. To know exactly which passageways are open and which are closed; to know which are fire walls and which are not; to have a mental picture of the exposures, the windows, the roof openings, the cornices, and all the other physical details important in fire-fighting—would so heighten the team work of a department that, like expert swordsmen, they could make their thrust, without loss of time, straight at the vulnerable part. There are a few cities where such practice, partially in effect, has already demonstrated its singular efficiency. The citizens of every town and city should demand this sort of service from its fire department.

Individual Responsibility

Then we must begin to place the responsibility upon the individual for fires. It is difficult to do that, I know, and yet it can be done. In France, if you have a fire and that fire damages your neighbor's property, you have to pay your neighbor's loss. That is very educative. It would be a very good thing if we had such a law in America. We can fix responsibility, however, and we can change our attitude of mind toward the man who has fires. When we look upon the man who has a fire as one who has done an unneighborly thing, as one who is a public offender unless he can prove that he was in no way responsible for that fire, then we will have begun to make headway. We must have enquiry into the causes of all fires, not merely an enquiry into the fire which is suspected to be the work of some incendiary. Nearly every fire is the result of some carelessness; and the careless man must be held up to public criticism as a man who has picked the pockets of the rest of us, because that is what it is in its last analysis. When we get fire marshals in every state or province who shall enquire into the causes of fires, I believe we will begin to correct our personal habits in respect to the things that cause fires.

Worn Pin Bearings on Steel Bridge Repaired During Traffic by Novel Methods

VERY unusual and delicate work in repairing worn parts of the four-track Harlem River bridge of the New York Central Railroad while in service has recently been accomplished by the use of special machinery and novel methods.

A number of the bearings of the chord pins at main panel point had become seriously worn, both in the riveted chord webs and on the pins themselves. The bearings were restored as good as new by boring out the pin holes to an increased diameter, turning down the ends of the worn pins and inserting steel bushings accurately fitted to the enlarged holes, all without removing the pins, interrupting service or obstructing the tracks or the channel.

No falsework was employed and no modifications of the trusses were made, the work being executed simply by means of an ingenious device which transferred the diagonal stresses to the chord members and held the pins in rigid position, without vibration or displacement, while the chord boring and pin turning and the placing of the bushing was in progress.

Fortunately the principal web members had satisfactory tight bearings on the pins, so that by thoroughly bracing and clamping the pins to the chords at the centre points the stresses could be transferred and positions maintained while the pin bearings in the two webs of the stiff chords were revised.

After the pin was properly clamped in position, the original bearing in the chord webs was temporarily eliminated, and a special boring machine with three cutting tools was centered on the pin by means of a sleeve screwed to the shoulder end of the pin and driven by a compressed air motor. This machine, always under very careful observation, worked with great accuracy, and cut out narrow annular holes in the chord webs, and also turned down the worn ends of the pins to true cylindrical surfaces. After this was accomplished, the machine was removed and the steel bushings, being finished at the site to accurate correspondence with the micrometer measurements of the shoulders and holes, were forced into position by hydraulic jacks, thus re-establishing perfect bearing between the pins and the chord webs. The work was executed by the railroad forces, J. W. Pfau, engineer of construction.—Contracting.

High-Silica Portland Cement Proves Satisfactory for Large Dam

IN determining the suitability of given raw material for the manufacture of portland cement it is usual to insist that the proportions of the principal components—lime, silica, alumina, and iron—lie within certain empirical limits. The possibility of producing satisfactory cements with materials whose composition lies outside of these limits is recognized by some authorities, but often the cement chemist relies upon the empirical formulas and arbitrarily rejects such materials without investigating whether they can be used and whether their use is economically justifiable.

High Silica Cement Justifiable in Certain Cases

A particular case (the construction of a large concrete dam in Spain) is cited below, in which experts pronounced the raw materials unsuitable because the proportion of silica was above the usual limits. Special economic conditions, however, justified the installation of a mill for manufacturing cement from these materials. A modern cement mill was erected and a very satisfactory high-silica cement was produced. This cement was compared with commercial cements, and it was found that high-silica cements are more reliable than average and high-alumina cements, and superior for uses which do not demand rapid hardening, but that they would frequently be rejected under a literal enforcement of present standard specifications. While high-silica cements will not come into the general market until purchasers are willing, under certain conditions, to pay more for them than for ordinary cements, there should be greater latitude in passing upon the suitability of such raw materials and in testing the resulting cements.

The conditions under which the manufacture of high-silica cement may be justifiable, in the light of the experience at the Barcelona dam, were discussed in a paper read by A. W. K. Billings at the annual meeting of the American Society for Testing Materials:

Highest Dam in Europe

In connection with extensive hydro-electric developments near Barcelona, Spain, climatic conditions made necessary a large reservoir for regulating the flow of the Noguera Pallaresa River. A suitable site was found near the town of Talarn, in Lerida Province, and here a very high dam of gravity section was built, using cyclopean concrete, the height above bedrock being 270 feet, or 341 feet above the lowest point in the cutoff wall, the length of crest 680 feet, and the volume 355,000 cubic yards in the dam proper. The dam is the fourth or fifth highest in the world, and much higher than any other in Europe; consequently very close attention was paid by the Spanish Government engineers to the design, materials for construction, and execution of the work.

The cost of transportation was an important factor, as the dam is situated in the foothills of the Pyrenees, 120 miles from Barcelona and 55 miles from the nearest railroad. The construction of a temporary railroad was impracticable, and all machinery, coal, and other materials had to be hauled to the site by animal and mechanical traction, over extremely bad roads. About 100,000 tons of cement were originally required, only a small part of which could have been supplied by existing Spanish mills; imported cement was expensive, and the added cost of transportation to the site and the delay in the work, if reliance had to be placed on these sources of supply, made it very desirable to manufacture a high-grade portland cement at or near the site.

Economic Conditions Justified Higher Cost

The dam is founded in a sandstone formation, which is overlaid by an argillaceous limestone or "marl" about 33 feet in thickness, and this in turn by a layer of siliceous limestone of similar thickness, from which the stone for the concrete was obtained. The surrounding country is composed of similar sedimentary deposits, all containing silica in considerable amount.

The materials were examined by an expert from London, and dupilcate samples were sent to another in New York. Both advised the company that the proportion of silica was too high to make satisfactory cement. An English manufacturing expert recommended a rather distant site where the proportion of silica was slightly lower, using a semi-wet process. After further careful study of the situation, the recommendation of an American cement mill engineer in the company's employ was approved, and it was decided to install the mill at the dam site and to use the materials immediately at hand. The economic conditions already indicated and the conviction that a high silica cement was especially suited for this work were considerations which outweighed the anticipated difficulty and extra cost of manufacture.

Waste Heat Utilized

A modern two-rotary dry process plant, electrically equipped throughout, having a nominal capacity of 1,500 barrels per day, was immediately ordered (August, 1912), installed as soon as received, and put in operation just one year later. Ball and tube mills for both raw and finish grinding were adopted principally because of labor conditions. Waste heat utilization was adopted because fuel was expensive, and a boiler plant was needed in any case for pushing the construction work while transmission lines, a smaller waterpower, and a steam plant on the railroad were being built. Motor drive was preferred because electric power would be available by the time the mill was installed, because later in its permanent location the mill would be a power customer of importance, and because the temporary location was a very cramped and irregular space on the cliff 300 feet above the river and a satisfactory mechanical drive was difficult.

It may be mentioned that when the construction of the dam was completed this mill was sold to a cement manufacturing company, delivered at the dam site, for over 80 per cent. of its initial cost delivered in Barcelona; the sale of electric power to the mill in its new location should bring in a revenue of $80,000 per year, and arrangements were included in the contract for the purchase of cement for future work at special prices. The financial as well as technical results were, therefore, deemed satisfactory.

During the early part of the work the Spanish Government engineers had a series of tests made at different laboratories comparing random samples of this and of two other high-grade Spanish cements and of one English cement which was in use on other work.

As was to be expected, the high-silica cement set within the usual time, but hardened very slowly; it was uniformly sound, and the autoclave test always gave satisfactory results. The strength at later periods was greater than that of first-class cements of usual composition, and the steady gain in long-time tests, which was especially evident in concrete made with this cement, was one of the most convincing indications of its reliability and sustained high strength. The Spanish Government engineers, at first very skeptical, became fully convinced of the high quality of this cement, and heartily approved the use of it.

No Natural Sand

A very extensive series of concrete tests was carried on during the execution of the work, but no attempt will be made to discuss them here, as the results are of somewhat special application. No natural sand whatever was used in the construction of the dam, the concrete being made from a carefully graded mixture of crushed limestone, ranging from 3 in. down to the finest dust. The density, impermeability, and strength were much higher than with ordinary sand and stone.

Cubes cut from the dam in some cases attained 5,700 to 6,200 pounds per square inch. The government required a minimum strength of 2,135 pounds per square inch, and the greatest compressive stress in the dam, calculated by Levy's theory, was about 285 pounds per square inch. The satisfactory results in the concrete work are due in part to the intelligent use of artificially graded, crushed mixtures and in part to the use of high-silica cement.

Contraction of Dam Imperceptible

The development of internal heat in the mass of concrete from the chemical reactions involved in the setting of the cement was much less marked than with cements containing more alumina, and consequently the subsequent contraction of the dam has been imperceptible. Usually in a mass of concrete of these dimensions the interior attains a temperature 20 or 30 degrees C. higher than the final average temperature, and when, after a few years, the latter is reached, considerable contraction is evident, amounting to one or two parts per thousand in linear dimensions. In the present case no such contraction is apparent, nor was there at any time evidence of appreciable rise of temperature due to chemical reactions. For this reason it is necessary, in working with high-silica cement, to pay special attention to protection from freezing in winter weather, as hardening is retarded and freezing of exposed surfaces occurs more rapidly.

In the manufacture of high-silica cement the temperature required in the kiln for the clinkering of the mix is considerably higher than for average cements, resulting in increased fuel consumption and cost of maintenance of the kiln lining. Considerable difficulty was experienced at the start, due to several causes, which were remedied, generally speaking, simultaneously. Insufficient care in selecting the materials, lack of experience of the native burners, improper air supply for the pulverized coal, the use of a local firebrick, and the need of more iron in the mixture were remedied without serious trouble, and the product was uniformly satisfactory thereafter, although the percentage of silica had to be watched closely at all times. It was found advantageous to add from 1 to 2 per cent. of low-grade iron ore to the mix to increase its fusibility.

Difficult to Estimate Increased Cost

It is not possible to calculate accurately the increased cost of manufacture of this cement, because no materials for a normal mix were available for comparison. It is estimated, however, that the increased coal consumption amounts to about 6 per cent. of the weight of the cement. The lining maintenance is not excessive, but depends greatly on the skill of the burner. If the proportion of iron can be controlled, by adding iron ore or otherwise, this difficulty is not important; otherwise a practical limit is quickly reached, on account of the rapid increase in fuel consumption.

Resists Disintegration from Gypsum, Alkali, and Sea Water

High-silica cement resists disintegration from exposure to the action of gypsum, alkali, and sea water, where high-alumina cements suffer serious damage. No tests were made in sea water, but a large irrigation system (the Canal of Aragon and Catalonia, operated by the Spanish Government) had experienced much difficulty in the maintenance of its tunnel and canal linings in gypsum-bearing formations, and at the request of the engineers in charge, a quantity of the high-silica cement was sent to be tested in comparison with a standard Spanish cement and a German iron cement.

Briquettes for tensile tests and pats were made and exposed for 175 days to the action of saline waters and mixtures. The tests show that the high-silica cement resists best, and that the only case of disintegration with this cement was with a 1:4 mortar immersed 175 days in a 28 per cent. solution of sulphate of sodium. The neat and 1:2½ mortar briquettes exposed to the same solution showed no loss of strength whatever. The results were, in fact, slightly higher than those for the check tests in pure water.

It is regretted that at the outset a thorough test in sea water with this cement was not started, but such an investigation was entirely beyond the scope of any contemplated work. The distance from the coast forbade attempting to use this cement in port works, and when the mill was later moved to its permanent location it was intended to manufacture a normal cement in order to meet commercial competition.

However, the effect of gypsum and other sulphates and alkalies on cement is very similar to that of sea water. It is the writer's conviction that, in selecting cement for work in sea water, or where exposed to sulphate and alkaline salts, preference should always be given to the one containing the most silica and the least alumina. The percentage of iron would thus be considered a secondary matter, and of more importance to the manufacturer in controlling the fusibility of the clinker than to the user in aiding to resist disintegration of the concrete.

High-Alumina Cement Preferable for Quick-Setting Work

In resume, if the customary empirical rules show that the raw materials will produce a normal cement no further investigation of this point is essential; if, however, they indicate the possibility of producing a cement of somewhat abnormal composition, a careful study of the qualities of the resulting cement, the purpose for which intended, and the attendant economic conditions, is essential before a decision is reached. A high-silica cement requires in manufacture closer attention, more fuel, and more frequent renewal of the kiln linings; an increase in the proportion of iron aids materially in controlling these difficulties, but high silica necessarily means increased cost of manufacture. In purely commercial competition with nearby mills in an open market such a cement would be at a considerable disadvantage. For ordinary reinforced concrete work, where quick hardening permits rapid construction and reduced cost of forms, a normal cement, or even one high in alumina, will be preferred. For dams, mass concrete work, reinforced work where no considerable stress is applied for several weeks or months, and especially in all cases where resistance to disintegration and high ultimate strength are important, a high-silica cement is preferable.

The user of cement for such work should accept low early strengths if good strength at later periods is assured, and may therefore permit, under intelligent inspection, a reduction below standard specifications in the requirements for routine acceptance tests. For work in sea water high-silica cement is worth more to the user and should command a higher price, in proportion to the increased cost of manufacture. More attention to the chemical composition of cements on the part of the engineer and user is desirable.

Steam Shovel Operation

Requirements for Shovels for Railway Work and Suggestions Regarding Care and Manipulation

IN the July Bulletin of the American Railway Engineering Association are published a number of recommendations covering steam shovel operations on railway work. These suggestions were originally incorporated in a report submitted by the Committee on Roadways at the last annual convention of the association in March, 1917. The following article is prepared from data contained in the above-mentioned bulletin:

The general requirements for steam shovels are either so standard as to require no particular explanation or so very special as to make generalities impossible. A standard size and type of shovel manufactured by a well-known and reliable maker in a general way carries in itself ample guarantee, both in regard to its proper design and in respect to the quality of materials and workmanship entering into its construction. Certain special features, however, are noted that should be carefully borne in mind when purchasing this equipment.

Size Determined By Conditions

The size of shovel used for any work must be decided by the character and quantity of excavation and the local conditions. In general, the commonest sizes are 60 to 80-ton shovels for the usual railway work. The following gradient of sizes may, however, be of service: For light grading, up to 25,000 cubic yard per mile, where a shovel can be used economically, a light revolving shovel is to be desired. For 25,000 to 40,000 cubic yards per mile a shovel of 50 tons is a good size. For 40,000 to 60,000 cubic yards per mile a shovel of 60 to 80 tons is well suited. For anything over 60,000 cubic yards per mile the shovel may run up to well over 100 tons economically if its transportation is not too expensive, and if the ground is fit to carry the weight on sub-grade during excavation.

The greatest cause of delay in steam shovel work is in the removal of the excavated material. Too great care and attention cannot be given to securing proper and ample equipment in the matter of cars and locomotives, and in the proper systematization of service, track, transportation, and disposal. The economic success of a steam shovel depends, above everything else, on having an empty car always ready to replace a loaded one under the dipper. Too great stress cannot be laid on this point. Careful management, through organization and unceasing superintendence and foresight only, however, can accomplish satisfactory results, even with a thoroughly-equipped plant.

As the plant charge against steam-shovel work is always an important item, especially where the haul is long, requiring a large equipment in cars and locomotives, continuous operation is desirable. For this reason either three eight-hour shifts or two ten-hour shifts are recommended. Where the service is not too trying on the machinery, three eight-hour shifts are more economical, if they do not upset other parts of the organization. When, however, the work is severe, two ten-hour shifts are preferable, as this arrangement gives two hours between each shift for repairs and overhaul in the plant. For night work, where electricity is not available, a small turbo-generator set, similar to that used on a locomotive, can be set up on the shovel for lighting the immediate works.

An old locomotive tender is a very valuable adjunct to a steam shovel, especially where delays may be caused from irregularity in coal and water supply.

Carelessness Causes Damage

The greatest cause of stoppage in the shovel proper is due to carelessness or incompetence in the operator. He should see that his engine-room and all moving parts are kept thoroughly cleaned and accessible. He should train his pit gang to watch the under-gearing and track. He must see that his boiler is washed out as often as necessary, depending on the water used, and that his flues, heads, and sheets are tight and in repair. He must continually inspect all parts liable to wear or extraordinary strain and make renewals before the accident occurs. He must have a light and accurate hand on the propelling lever and must judge his load on the hoisting chain or cable, especially in an over-powered shovel. Heavy breakage in hoisting chains in such a case is almost always due to an unskilled or careless operator. The mechanical delays on a good shovel operated by a good runner are almost negligible.

A good works superintendent or master mechanic can develop good shovel runners if he has time and patience. This, of course, is often difficult on railway work, especially in the maintenance of way operations. With average runners the commonest repairs are as follows: Hoisting cables, hoisting chains, swinging cable, teeth and tooth bases, friction bands and blocks, "U" bolts or double bolts and yoke, pinions (especially shipper shaft), dipper latch and hinges, dipper stick (in hard digging), sheaves and pins (especially at end of boom and padlock block), shipper shaft, crank-shaft on boom engine, eccentric straps, bearings, arm jacks, rack bolts, clevis strap between dipper and bail, ordinary engine repairs, ordinary boiler repairs, ordinary pipe fittings.

Repairs Small With Good Runner

In the above list of most common repairs much of the trouble is undoubtedly due to lack of proper inspection and judgment in removing worn parts before they actually break, also to careless handling of the shovel when unusual strains arise in heavy digging. Where a good runner is secured the repairs will be very small. Where the work is near a base of supplies, the stock parts carried may be very small. There are also many repairs that may be made by the job blacksmith without special stock.

Locomotives for Steam Shovel Work

The type and size of locomotives used on steam shovel work must depend on the character of the work, weight of trains, the length of haul, and the local conditions. On maintenance work ordinary road engines are usually well suited, especially if an ample tail track is provided in the pit that too much shunting is not required. On construction, where the track is apt to be bad and curves abrupt the four or six-wheeled saddle-tank type is preferable, at least near the shovel. If the haul is long and the track is fair, heavier locomotives should be used in transportation.

In general, on construction where the tracks are inclined to be rough and curves sharp, the shorter the wheel base on a locomotive the better, within limits. Where road engines, or even heavy switch engines, are used, there is always danger of derailments and frame breakage. Where "dinkeys" are used, it is well to pay special attention to springs, brakes, and the location of the centre of gravity with reference to the wheel base. Some makes are so balanced that under heavy loads and on steep grades two wheels are sometimes lifted clear off the track, with the natural resulting delays, if not damage.

Shovel Track

The shovel track should be made up of 6 ft. sections, with strap connections. Bridles of ½ in. by 2 in. iron should be used, with wedge grips. A notched tie should be used as a check, behind the front trucks, supported by steel saddle clamps attached to the rail with wedged grips. Similar clamps should be placed before the front wheel without tie check. Nothing less than 60-pound rail should be used under a shovel, and heavier rail should be used under the larger models. No spikes are used.

On the muck track in tunnels standard-length rails are used, spiked to the ties. Where no tail track is possible and the excavation is at a breast, drive rails are very useful. These consist of half-length rails laid on their sides, with the ball of the rail against the inside of the web of the last rail spiked down. As the breast is cleared away, these short rails are driven ahead, and the cars are run out on the balls of the capsized rails. When a half-length is thus driven out, it is turned right side up and spiked lightly in position and the other half-length driven out in a similar manner.

Good Roads as a Municipal Problem

$110,000,000 Invested in Roads in Province of Ontario and $200,000,000, in Rolling Stock—Public Leadership Needed

By S. L. Squire*

ROADS form a municipal problem because our highways afford one of our largest spending departments. And all honest municipal men are desirous of securing for their ratepayers one hundred cents' value for every dollar spent. It is a further problem because of the broad service the highways perform, and yet not as efficient a service as might be obtained.

The subject assigned is the better for analysis, and one may be justified in asking why are roads "municipal," and then consider some of the problems. My desire is to view the subject from a provincial standpoint as affecting municipalities in order that we may get a glimpse of the bigness of the question.

Ownership of Highways

Highways are "municipal" because of their ownership. They have a real and nominal ownership and an operating partner. The nominal owners are the municipalities—the real owner the crown. The operating partner is the general public. The rolling stock is privately owned. To the nominal owners is delegated the responsibility of constructing, maintaining, and improving the roads. They, too, must defend an action for damages. They are allowed to assess the ratepayers for the necessary money required, and are responsible to them. The fact that highway control has been so long a municipal matter has had the tendency to narrow and not broaden the viewpoint. The standards have become local and not national. The improvement has been sectional and not continuous. This forms one of the problems.

The public as the operating partner not only uses the highway for business and pleasure, but delegates himself as road inspector and freely finds fault with all that he thinks is bad, occasionally, however, offering some helpful suggestion. The public has always considered itself warranted to elect whoever it fancied as municipal councillors and then, as a reward, criticize their actions, and this is not always charitably.

$110,000,000 Invested in Roads in Ontario

Let us consider of what the highways of the province consist, dealing with investment and service performed. It may not be out of place to furnish some figures which I hope may prove interesting and illuminating in connection with the ownership and development of the highway system of the province as they represent in total the "highest capitalized public owned business in Canada."

The Province of Ontario has a map measurement of roads slightly in excess of 58,000 miles. While all of these roads are not of a uniform width, they would average 60 feet, and require a land acreage for road purposes of 460,000 acres, which, if valued without the cost of improvement at $30 per acre, an average less than farm land assessment, the investment in land is worth $13,800,000. The cost of improvement, including grading, drainage, bridges and surfacing estimated at an average of $1,000 per mile, would be $58,000,000, making a total permanent investment in county roads of $71,800,000. The maintenance of the investment costs in cash and labor over $3,000,000 annually. The counties are spending at the rate of $900,000 annually. This large amount does not include the city and town streets, the capital invested in which, I like to consider as the cost of the terminals. Nearly all traffic centres

* Before Ontario Municipal Association.

on these, and the total investment in 31 cities and towns, on their street improvement, is over $20,000,000, not including land value. The 250 cities, towns, and villages in the province would probably have an investment of $40,000,000; making the total roadbed investment in the Province of Ontario over $110,000,000.

This large public investment furnishes a means whereon the privately owned rolling stock may operate. The value of the rolling stock needs to be considered—the automobile, the farmers' buggies, wagons and horse-power, the companies' trucks, etc. Investment in these is necessary because of the roads, and the roads are necessary because of the investment. The rolling stock investment, privately owned, reaches over $200,000,000.

Motor Cars Travel More Than Railways

Let us briefly consider highway traffic on the roads of Ontario. This, of course, can only be approximately estimated. The figures presented, however, have been submitted and carefully checked by some who have made a study of this matter. There are approximately 75,000 automobiles in the province, averaging 4,000 miles yearly, thus traveling 300,000,000 road miles, which is seven times the distance traveled by all the passenger trains in the Dominion of Canada. They, the automobiles, carried 60,000,000 passengers, averaging four to the car, for an average trip of twenty miles. This is one and one-half times the number of passengers carried by all the railroads in the province.

The necessity of the highways and the important functions which they perform, reflecting the progress of civilization, add to the problems of the municipalities. There is a greater demand for improved roads caused by traffic conditions. This illuminated the problems and caused us to consider their solution.

Who Should Pay for Road?

Considerable controversy has been occasioned by one phase of the subject—cost. Who should pay for the roads The spirit of co-operation is now evidenced, and with government assistance the assessment for highway improvement has been placed upon the government, the cities, and the rural municipalities, paying as nearly as can be arranged in proportion to benefit. The money required may be obtained by the municipalities by annual levy or the issue of debentures. No municipality should issue bonds for any public work, having the bonds outlive the life of the work. The issuing of bonds should be discouraged. Pay as you go should be the rule, and should be encouraged. The people have discovered during the past three years that money is available for important work. Bonds should never be issued for maintenance.

Builders Must Have Qualifications

The municipal council is the board of directors, elected by the people to supervise the construction and maintenance of the highways in the municipality. In 95 per cent. of the rural municipalities this work is delegated to pathmasters who are appointed annually by the council. The qualifications of these pathmasters as road builders are often discovered only when a good roadbed has been destroyed. The farce of trying to create good roads by bad management is daily exposed. To obtain efficient management in road-building no one should be employed as manager or overseer who does not possess recognized qualifications, and when a man is discovered who has gained knowledge and experience he should be retained. If the municipal control of the highways is continued and good roads obtained, not only will roads have to be standardized, but men who build them will have to be standardized also.

Increased speed in traveling has shown new dangers. Many roads possess sharp turns where slight differences occur in surveys. Damage actions may never occur if these are straightened by purchasing slight deviation. "Safety first" can be practised with good effect.

Indifference Adds Difficulties

Serious problems are occasioned by the number of opinions to satisfy, and by indifference on the part of ratepayers. It is often difficult to get the public to take an intelligent interest in that which is essentially its own business. The people do not realize the immense annual waste occasioned by experimenting with the highways.

Problems are prevalent not only of management and administration, but also of ascertaining just the best kind of road to build. There are men who will tell you that this or that kind of road is the kind, and only kind, to be constructed. I submit that, with present-day traffic, the perfect road has not yet been discovered. That road which can be constructed and maintained at the lowest cost, keeping in mind traffic conditions and efficiency, is undoubtedly the best road. The problem is to find the road suited to your municipality. I submit that with councils changed annually this is a serious difficulty.

Problems when correctly solved prove blessings in disguise. Agitation for improved highways preceded the automobile. As "coming events cast their shadows before," the automobile has produced road problems, but I believe it is hastening the day when good roads will become an economic asset in every municipality, and this will prove a national blessing.

Leadership Needed

The public needs leadership. Legislation must not precede public opinion to too great an extent. There are municipal men to-day who are convinced that changes are necessary if good roads are to be obtained.

The municipal officials should be the leaders of public opinion. If by such leadership the public could obtain an appreciation of the magnitude of the good roads question, having a broader conception of the important functions the highways perform, the high place they occupy in the economy of present-day civilization, and the immense waste in labor and capital occasioned by the system employed in most of the municipalities, the ratepayers in mass would demand changes in administration which would efface the problems and produce a system of good roads in our province comparable with the best highways of Europe.

In a petition to Sir Lomer Gouin, the Montreal Citizens' Association ask for the appointment of a governing commission by the Lieutenant-Governor, in order to ensure a better business management of the city's affairs. It is suggested that the commission should include Mr. J. S. Dennis, president of the Canadian Society of Civil Engineers, and Hr. Hugh Vallance, president of the Architects' Association of the Province of Quebec.

The opening lecture of the season of the Canadian Society of Civil Engineers, Montreal, will be delivered to-morrow, October 11. General Sir Alexander Bertram, late chairman of the Imperial Munitions Board, will speak on the manufacture of munitions. The address will be illustrated.

Waters and Water Powers of Canada

What Has Been Done by the Commission of Conservation Toward Recording the Available Data—Provincial Supervision of Water Rights

By Leo. G. Denis*

DURING the year 1916 two important reports were published under the direction of the Committee on Waters and Water-Powers, namely, the reports on the Waterworks and Sewerage Systems of Canada and the Water-Powers of Manitoba, Saskatchewan, and Alberta.

The report on Waterworks and Sewerage Systems is the second edition of this publication, and includes much more detailed and extensive data than the first. The main portion of the report is devoted to physical and financial data of all waterworks and sewerage systems of the Dominion. There are, in addition, a number of tables, summarizing the most salient points extracted from the information contained in the body of the report. Thus some 528 waterworks and 279 sewerage systems are described in as much detail as space would allow, while the tables reveal data throwing light on the importance of these systems in Canada. For instance, the 528 waterworks plants represent a capital outlay of nearly $124,000,000, while the 279 sewerage systems have cost over $77,000,000.

Few Have Adopted Filtration

Water filtration is being used in connection with many of our domestic water supplies, but not as generally as might be expected. For instance, out of 216 systems obtaining their supply from possibly polluted sources we find only 72 have adopted filtration. Most of the unfiltered systems disinfect the supply with hypochlorite, or similar treatment, but this cannot be considered satisfactory, except as a precautionary measure pending installation of filtration. The importance of the gravity system, where the supply is obtained from distant lakes or streams, is also to be noted. There are over one hundred of these systems; among the larger cities thus supplied are Halifax, St. John, N.B., Quebec, Fort William, Calgary, Victoria, Vancouver, and New Westminster, while Winnipeg will also soon be included.

Excessive Water Consumption

Excessive water consumption in most of our cities is another important point. The average daily consumption is 111 gallons per capita, while individual centres of fairly large size reach as high as 292 gallons. These figures could unquestionably be lowered; in many municipalities in Great Britain the consumption is as low as 25 gallons, and in but few is it more than 70 gallons per capita.

As stated in the first edition of this report, the pollution of our inland waters by untreated sewage is becoming a serious problem. More than 60 of our inland water systems receive sewage without the least attempt being made to prevent it spreading disease; 180 municipalities contribute to this very undesirable state of affairs. It is to be noted, however, that conditions in this respect are rapidly improving, particularly in the western portions of the Dominion. New sewerage systems have either been constructed with treatment plants, or are being designed and installed with a view to having treatment plants added in the near future, at the minimum expense.

Data on Water-Powers of the West

The report on Water Powers of Manitoba, Saskatchewan, and Alberta was published during the latter part of the year, its publication having been delayed to allow of the inclusion of later data which had become available, thus adding greatly to the value of the report and bringing it up to date. This additional information was obtained principally through the water-power and irrigation branches of the Department of the Interior, the organizations charged with the administration of water-power and irrigation respectively in the Prairie Provinces.

The report contains a complete compendium of all available information on the subject and will prove most useful as a reference book, especially to anyone contemplating the development of or who is otherwise interested in water-powers in this portion of the Dominion. An important fact brought out is that, while portions of the territory in the south are deficient in water-powers, the northern portions abound in this very desirable natural resource, and the information contained in this report should correct the erroneous opinion sometimes expressed that similar conditions obtain in the north as are found in some of the better-known portions of the provinces.

With the publication of the report, by Mr. A. V. White, on Water-Powers of British Columbia, complete preliminary information on the importance and possibilities of even our remotest water-powers will have become available, while, from accompanying maps, the position of each power may be ascertained. This survey was of great importance, one of its principal objects being to pave the way to further and more detailed investigations of these natural resources.

Crown Rights to Water Powers

In this connection it is gratifying to note that the measures which the Commission of Conservation has consistently urged since its creation, relative to the disposal of water-powers by the crown, to stream flow and to other investigations regarding them, are enforced and being practised in almost every province.

Nova Scotia, in 1914, appointed the Nova Scotia Water-Power Commission, with power to make regulations regarding the disposal and administration of water-powers. The commission has been very active during the past two years in systematic investigations of detailed power possibilities and in the establishment of stream-gauging stations, this work being carried on in co-operation with the Dominion Water-Power Branch, Department of Interior.

Quebec and Ontario Organization

In Quebec the government has two organizations working in co-operation in connection with its water-powers. The Hydraulic Branch of the Department of Lands and Forests has charge of leasing and administering them, while the Quebec Streams Commission, organized in 1912, is actively pursuing water-power investigations and undertaking important conservation

*Hydro-electric engineer, Commission of Conservation storage projects, such as at La Loutre, on the St. Maurice, the third largest in the world, as well as on the St. Francis and other rivers. Regulations for the disposal of water-powers in Quebec are now adequate, and the emphyteutic, or conditional long-term license given for periods of from 25 to 99 years assures development within a limited time under government supervision, and provides for a fair remuneration to the crown, thus encouraging bona fide projects.

Ontario was one of the first provinces to undertake proper regulation and administration of its water-powers. The administration, which comes under the jurisdiction of the Minister of Lands, Forests, and Mines, as well as investigations in connection with these, is in the hands of the Hydro-Electric Power Commission of Ontario, created in 1906, and the regulations for granting water-power privileges embody strict conditions, limiting licenses to twenty years and provide for approval of plans, also government supervision of development, which must be completed with a limited time and, if necessary, later extended to satisfy public demand. This commission is very active in its investigations regarding undeveloped power, and, according to its last report, has 69 regular stream measurement stations and many other temporary ones. Besides this work, the Hydro-Electric Power Commission has followed its primary object with excellent results, namely, to serve as a medium, both physically and otherwise, between interests generating hydro-electric energy and the users or municipalities. Upward of 200 of the latter are now supplied with electric energy through the commission, for which purpose extensive electric transmission lines have been constructed.

Federal Control of Water-Powers in Prairie Provinces

In the Prairie Provinces water-powers are under federal control, and the Department of the Interior both administers and conducts investigations in connection with these. All water-powers are licensed for a term of 21 years, which is renewable for three further similar periods, with certain readjustments, while development within specified time is provided for and further assured by having an agreement for the period of construction and granting the license proper only after completion of work to the satisfaction of the minister. Investigation work, surveys and explorations are being pursued in connection with the Northern water-powers, while detailed surveys of some of the large rivers in the South have permitted elaborate plans and estimates to be prepared in connection with possible water-power development. Numerous stream measurement stations have been established, and surveys and other investigations in connection with irrigation are also included.

Five-Year Leases in British Columbia

The water-powers of British Columbia are under the control of the Provincial Department of Lands, through its Water Rights Branch, and are administered under the Water Act of 1914. The latter provides for the disposal of water-powers by license, with fair annual rental, the latter being readjusted every five years, also, for the approval of plans and the completion of works within limited time. The Water Rights Branch also pursues systematic investigations and reconnaissance surveys. The more accessible portions of the province are being thoroughly covered, while upward of 200 regular stream measurement stations have been established in connection with the work.

This work should be further encouraged and extended, as the proper and intelligent disposal, administration, utilization, and conservation of our water-powers can only be expected after thorough investigations and surveys, which should be undertaken by the various government organizations interested, and not left to private parties, as has often been the case in the past.

Stream Flow and Level Variation

A commencement has been made at collecting stream flow and level variation. These data, which are otherwise not available, are mostly being obtained by correspondence with operating hydraulic plants, or with private parties. The Province of Quebec has practically all been covered, and the results are very encouraging. The correspondents appreciate the value of the work, and companies and individuals keeping records have willingly gone to considerable trouble to supply the desired information, while others have expressed a wish to co-operate in keeping future records. In this connection studies of the flow of the St. Lawrence River were also undertaken and have progressed satisfactorily.

As an outcome of the power survey recently undertaken by the commission it has been found advisable to obtain additional and more detailed descriptive information respecting the electric power plants throughout the Dominion. The importance which electric energy has at present and in the near future will have in the industrial development of Canada is appreciated. While this is particularly true of hydro-electric energy, steam, gas, and oil-operated electric plants also offer special interest with regard to power conditions. These latter plants are usually of large size, and, as the question of economical production of power is the principal item, they can usually be taken as a criterion, so far as power conditions are concerned. The additional data are being obtained by correspondence, and, when complete, will prove of much value.

Many articles and short reports have been supplied during the year, either on our own initiative or in answer to special requests. The various subjects include summary reports on the water-powers of the Province of Quebec and of the Prairie Provinces, developed and undeveloped water-powers in Canada, water-power regulations, water-power conditions at Sault Ste. Marie, water supply and sewerage situation in Canada, floods, electric heating, and the industrial importance of our water-powers.

Shortage of Power

One of the most important considerations in many portions of the Dominion has been that of need of additional power. This has been particularly emphasized in the Niagara district, where the principal cause may be attributed to the enormous quantity evaporated. Other indications are the permission for the full diversion of the St. Mary River (Sault Ste. Marie) at its minimum flow and the recent statement of one of the officials of the Shawinigan Co., which supplies power to Montreal from its plant on the St. Maurice, that they were taxed to their full extent, with heavier demands still being made. In the above, as well as in other cases which could be cited, it is noteworthy that, where the supply is not equal to the demand, this condition has usually been brought about, not through actual lack of water-power, but more frequently through the improper timing of improvements, extensions, and new developments; instead of keeping ahead of the demand the hydro-electric companies have allowed themselves to be overtaken by it. The large amount of power required by munition factories is an important factor in the increased requirements, but other industries are also large buyers of energy.

Water Diversion Through Chicago Canal

Closely allied with the power shortage at Niagara, as well as at all water-powers of the St. Lawrence, is the question of water diversion through the Chicago sanitary canal. One feature, which has perhaps not been sufficiently emphasized in connection with this scheme, has been forcibly brought out in recently-published figures respecting the power plant, which evidently is a very important factor of the project. The figures show that the disposal of sewage is only a secondary consideration when compared with the financial aspect of the hydro-electric power development. This is further accentuated by the fact that the estimated profits from the extensions now under construction would be about 100 per cent. Figures showing the growth of the power plant give 15,278 h.p., with earnings of $130,936, for the year 1908, while, in 1915, these figures had reached 55,640 h.p. and $932,566 respectively. Although the authorized diversion is but 4,167 cubic feet per second, it is notorious that about 8,000 cubic feet per second is actually flowing through the Chicago River.

New Style of Abutment Uses Less Concrete Than Old Gravity Type

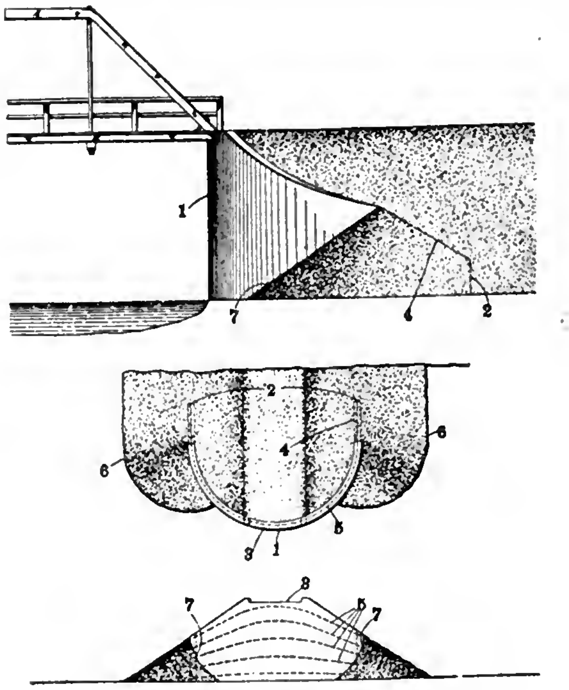
Construction engineers are rightfully making every effort to evolve new types of structures which will cut the cost of construction by a more economical use of materials. The old type of gravity abutment is especially wasteful in the use of concrete, since the weight of the concrete therein must be sufficient to resist the thrust of the earth fill it retains. A great economy was affected with the advent of the reinforced concrete abutment patterned after the gravity abutment in its general features, but making use of the earth fill resting on the base to resist the horizontal earth thrust, rather than depending on the bulk of the abutment only for this purpose. Quite recently, however, a reinforced concrete abutment has been developed which is still more economical in use of materials and much simpler in arrangement of reinforcement, because of its semicircular shape. It is described in the Cement World.

Semi-Circular in Shape

This new type, called the Thompson abutment (after its inventor, M. T. Thompson) as shown in the accompanying illustration, is of semi-circular shape with the extremities of the semi-circle carried back tangentially and at the same time sloping downward so as to be completely buried in the fill. By thus anchoring the ends of abutment, the stresses therein are rendered purely tensile, due to the pressure exerted by the fill, the same as the stresses in a grain bin or tank, and these stresses are taken up by reinforcing bars in middle of wall following the slope of the ends or wings of abutment. Since the main stresses, those due to the earth pressure are purely tensile, a minimum thickness of wall is required to act as a covering for reinforcement and a retainer of the fill. For practical reasons a wall thickness of 1 foot is used for walls from 12 to 30 feet high. The first abutment of this type, 28 feet high above foundation and retaining an earth embankment about 24 feet wide at the top, was built with the uniform thickness of 15 inches from top to bottom, but demonstrated such excess of stability and adequacy that succeeding abutments were constructed with a thickness of 12 inches.

Economical in Concrete

A spread footing, 3 feet wide, for an abutment 24 feet high, is provided under about the front-third of the abutment. This footing is reinforced and anchored to the wall with stub bars. The tangential continuations of the semi-circular portion of the wall are so proportioned that aided by the weight of wall and earth superimposed on the slope of wall their surfaces in contact with the fill will by skin friction resist the tendency to overturn with a factor of safety of between 4 and 5 (4.8 for a 24-foot abutment). For a 24-foot wall the maximum pressure under the footings is found to be about 2,500 pounds. The economy of an abutment of this type is evidenced by the fact that only 65 cubic yards of concrete and 2½ tons of



Semi-circular abutment is economical of material.

reinforcing steel is required for a 24-foot height, and that the reinforcement is simple and easy to place. Then also there are no wing walls as used in ordinary retaining walls, which tend to crack and separate from the main portion of abutment due to the difference in earth pressures on the parts mentioned. The stresses in the front portion of this new type being evenly distributed, and because of the shape of abutment and character of stresses and reinforcement employed therein, there is no tendency for the abutment to rupture in vertical lines.

This new abutment was developed by Mr. Thompson while engineer in charge of road and bridge work in connection with the construction of the Mississippi River Power Company's dam at Keokuk, Iowa, in 1912-1913. This work made necessary the construction of a number of abutments for highway bridges crossing the streams which flow into the Mississippi. The old type of gravity abutment required such quantities of material as to make its cost comparatively prohibitive. To meet this difficulty, numerous other types of reinforced concrete structures requiring less material were investigated, but they possessed the drawbacks and intricate reinforcement and heavy bending movements which frequently result in rupture.

Construction of Brick Roads in Chicago

By H. J. Fixmer*

IN all types of pavement construction is is our endeavor to build a pavement that will fulfill the requirements of the traffic using it. The kind of traffic using the city street and main road to-day is greater in volume and weight and more rapid and important than the traffic of former days. Brick construction is, as a general rule, only specified on thorofares inviting this kind of traffic. After analyzing the effects imposed on pavement construction by mixed types of vehicles, with the motor truck predominating, we are able, in time, to devise or indicate the methods to be observed in evolving a pavement that will accommodate the traffic in a satisfactory manner. The increased weight of the heavy motor truck is, statically considered, better distributed over the surface of the pavement, because of the width and resilient quality of the tire. This, in turn, is greatly counterbalanced by the impact produced by the increased speed of the vehicle. The driving wheels of the motor truck generate more friction and exert a powerful shearing force on the surface of the pavement.

In addition to the forces constantly exerted, but in varying amount, by the traffic on the surface of the pavement, there are present at times other natural forces tending to destroy the pavement structure.

Natural Forces on Pavements

These forces are, briefly, expansion and contraction, caused by climatic changes; the action of free water, in the form of frost, as a solvent, as a carrier, and as an agency in compacting soils, causing settlement; and decay or deterioration caused by defects in the material, or a combination of the destructive agencies of nature.

The subgrade must be properly compacted and drained. This requirement is worth all it costs, regardless of the type of pavement used, because it is virtually of permanent value.

The base or foundation of the pavement should be an unyielding structure, preferably of concrete. Where a grout filler is used good results have been secured with a macadam base, but for heavy traffic concrete is more reliable. The quality and thickness of the concrete require study, and should be proportioned to satisfy the conditions of the subgrade character of wearing surface and the amount and weight of traffic to be borne.

On the foundation there is usually placed a so-called "cushion" of sand, bituminous mastic or cement mortar.

Cushion Layer

The purpose of this layer is to form a smooth surface that will adapt itself to the uneven surface of the base and in inequalities of the bottom surface of the individual brick. Until recently it was believed that the "cushion" served to reduce the effect of impact on the surface of the individual brick. It is now well recognized that the sole function of the "cushion" is to afford an even bearing for the brick on the foundation. Sand serves well for this purpose, provided it can be kept in rigid position. Experience has shown that vibration and the percolation of water tend to shift the sand, causing the pavement surface to settle unevenly. For this reason it is considered better practice to add cement to the sand in the proportion of 1 to 3 or 1 to 4, and wet the cushion through the joints after the bricks are properly bedded. This enables the cushion to set up and maintain an even bearing on the concrete, regardless of the joint filler used. A serious objection to the sand cushion is its tendency to work up to the top of the brick through the joints, particularly if the pavement is rolled too much. A sand having up to 10 per cent. of loam will not roll up in the joints as much as a clean, fine sand. Where an asphalt or tar filler is used it is no disadvantage to have some of the sand come up in the joints, for it is readily penetrated by the hot bitumen and becomes a stiff mastic. Where the filler is grout the presence of sand in the joints prevents the penetration of the filler and results in the development of weak spots, which quickly become loose. The sand in the joints filters the water out, leaving a thin mortar, which dries out and does not set up properly. Where a grout filler is to be used, a mortar cushion should be provided. This cushion can be laid dry and wetted by sprinkling either immediately before laying the bricks or through the joints after the bricks are rolled.

Shows Endurance of Brick

Because of the effect of impact of traffic a smooth surface is imperative. Many years ago brick pavements were rolled with a horse-drawn roller and the joints filled with sand. A few of these pavements are in existence to-day as monuments to the enduring quality of brick as a paving material. The joints are open and very wide, due to the rounding off of the upper edges of the individual brick. Even where the bricks were narrow there are few broken bricks.

It can be safely stated that brick is highly resistant to fracture or crushing where evenly bedded. It wears by abrasion, the amount depending on the uniform hardness or toughness of the brick and the support or protection given the joints. The quality of brick is well standardized, and its toughness, both as to degree and uniformity, readily tested.

Having secured an even surface by proper rolling and having the bricks evenly bedded on a fixed cushion, our remaining problem is to secure an adequate joint filler. The joint filler must be one that remains in place at the top surface to protect the joints and maintain an even wearing surface.

Cement Grout a Good Filler

In Chicago four kinds of joint filler have been used, namely, sand, tar, asphalt, and cement grout. Sand is not satisfactory. Tar has, as a rule, given poor results, particularly in recent years. It wears, breaks or flows away, leaving the upper part of the joint exposed to wear and the accumulation of filth. It is believed that the extreme range of temperature in this locality destroys its efficiency, and for this reason we are limiting ourselves to the use of asphalt and cement grout. Asphalt has given general satisfaction. It adheres well to the sides and tops of the bricks, filling any surface inequality and giving a smooth, durable surface. Pavements five years old have the asphalt flush with the joints and a thin surfacing in spots. Where the grades of the street vary greatly or are excessive, an asphalt filler should be preferred. The use of the grout filler has been revived this year, and where a grout cushion is used excellent results are expected.

The grout is mixed in the standard proportion of equal parts of cement and sand. On some jobs the

*Division engineer in charge paving construction, Board of Local Improvement, Chicago. In Municipal Engineering.

standard hand-mixing box was used. On one job the material was mixed in a small batch mixer and conveyed to the grouting area in carts having revolving paddles fixed to the axle of the wheels. In this way the mixture was kept agitated, and when dumped was of even color and uniform consistency. The grout was applied in two courses, and rarely required three applications. A stiff broom was used with the thin, or first, application, and a rubber squeegee with the final application. A smooth surface was secured, the joints filled flush, and any slight defects in the brick evenly filled. The streets were barricaded seven or more days and kept sprinkled for the first three days. Where a repressed brick on a mortar cushion was used, one barrel of cement filled 29 square yards of pavement. Where a lug (wire-cut) brick was used on a sand cushion, one barrel of cement was used to form 24 to 28 square yards of pavement. This variation is due to the amount of sand coming up in the joints. On the cement-sand cushion, mixed one part cement to four parts sand, one barrel of cement laid 18 square yards 1 inch thick.

Where a sand cushion was used some trouble was experienced in getting the proper amount of grout in the joints, due to the cushion working up, necessitating taking up and relaying the brick.

Track Allowance Paved With Granite Blocks

On the brick pavements laid under my direction this year the middle 16 feet is occupied and constructed by the street railway company. This middle strip is paved with granite blocks with a grout filler. On these streets four rows of granite blocks are laid outside the rail on a mortar cushion. On one street the granite strips were filled with tar and torpedo sand, the other streets having a granite filled with grout similar to the adjacent brick pavement. An expansion joint, filled with bitumen, is provided along the face of the curb and continued across intersecting streets and alleys. No transverse expansion joints are built.

The purpose of using the four rows of granite blocks outside the rail was to take care of the excessive wear due to the habit of vehicles driving along the rails and turning out abruptly. The four rows extend beyond the ends of the ties, and, where the joints are filled with bitumen, little, if any, vibration is communicated to the adjacent monolithic brick slab.

Crown Made Slight

In order to minimize the effect of expansion, the crown was made as slight as practicable, and no abrupt changes, such as raised cross-walks, built at intersecting streets, as was formerly the practice. The pavement is built flush with the curb for a width of six feet, corresponding with the sidewalk, across the alley and street intersections, along the line of the maximum pedestrian traffic. At the curb corners the pavement is four to six inches below the rail (curb grade), running thence to the inlet located about fifty feet from the curb corner. The crown at the inlet varies from eight to ten inches below the rail or curb, depending on the width of the roadway. This construction creates a step of from five to seven inches at the cross-walk crossing the street. This tends to cause a pedestrian to pause before crossing the busy street and eliminates the familiar "bumb" in the line of greatest vehicle traffic. A grout-filled brick pavement laid on a 1-in. mortar cushion, on a 6-in. cement base, is rigid and semi-monolithic. It is believed that this type will prove satisfactory for the traffic and will resist climatic changes. The cushion should set up with the grout in the joints, permitting the concrete to slide under the cushion and thus not communicate cracks from the base up through the pavement. Since the pavement is smooth, its rigidity, or lack of (alleged) "elasticity" gives a more durable and comfortable surface for all types of wheel traffic. All vehicles are now equipped with springs and a majority travel on rubber tires.

The horse is destined to disappear from the city street. If used, he should be shod with rubber or other smooth shoes.

Pavements Not Made to Tear Up

Some objection has been raised that the grout-filled pavement is difficult to tear up, and even more difficult to repair. This is true. However, we are not building pavements for the purpose of tearing them up readily. This is a questionable, or at most an incidental, defect. This type of pavement can be properly repaired, but it requires skill and care. It is the writer's opinion that an asphalt or grout-filled brick pavement on a 1-in. mortar cushion, on a good 6-in. concrete base, is an excellent type for the normal business or car-line street. It will require very little repairs or maintenance. Where the filler wears down, the pavement can be restored by a light application of hot asphalt, with a sand dressing. If this is done regularly, say every three to five years, the pavement should last from twenty-five to forty years and be in a smooth condition all that time. The new ideal pavement must have the qualities of smoothness, rigidity, durability, strength, good traction, be comfortable to ride upon, and be easily cleaned. A properly-constructed brick pavement realizes all these advantages to a noticeable extent.

Vacuum Street Cleaning Tried in Missouri Cities with Success

STREET-CLEANING by the vacuum-cleaner system has been on trial recently at Kansas City and St. Louis, Mo. The machine consists of a four-wheel motor truck, which carries the machinery and hauls a closed wagon, into which the dirt is discharged. This outfit hauls the dirt to the dump.

Two machines cover a district of 124 blocks, with about 2,040,000 square feet of pavement. They start at 7 p.m., and finish the work usually in about eight hours. Fred. A. Richardson, street cleaning commissioner, says that in the first 30 nights they removed 497,134 pounds of dust, dirt, and litter. Of this 40 per cent. was fine dust.

A patrolman attends the machine to handle the space around dead cars, and also to pick up wet or damp material, which is placed in a large garbage can hung on the back part of the machine.

This district was formerly cleaned by 140 patrolmen, but with the machines this number has been reduced 50 per cent. The character of the pavement is mainly asphalt and wood block, with a few blocks of Medina stone in good condition.

The gutter machine travels two miles per hour and must make two cuts. The centre machine runs five miles per hour and makes as many cuts as are required with the 8½ ft. width of the cleaning device. On Grand Avenue, for instance, eleven cuts are necessary.

Sand Wears Blades

The wagon holds 20,000 pounds, or about 9 cubic yards of dirt. The fine material is heavy, due to the excessive amount of sand used on street railway tracks because of the steep hills in Kansas City. This sand wears the machine quite badly. In 27 nights the blower blades are cut out, although they are 3/8 in. thick. Wood is to be tried. The back part of the fan is of 1/2 in. boiler plate, but it is cut out in about the same time. The broom must be renewed in about 20 nights. Before the war these brooms cost $30; now the price is $106.

A flexible pipe 12 in. in diameter and 62 in. long connects the sweeper to the dirt box. It is of No. 4 duck canvas, with a spiral wire covering. It lasts but two nights. A lining of rubber is to be tried.

Although the machine is 23 ft. long, it can be turned in a radius of 17 ft., as it has a three-point suspension. It cannot be backed. The sweeper weighs 14,000 pounds, and the wagon or trailer 7,000 pounds.

The machines used at St. Louis, Mo., clean 140 blocks of congested district each night, between 7 p.m. and 5 a.m. About 40 per cent. of the material will pass through a 200-mesh sieve. There are 31 blocks of poor granite block paving. The remainder is in fair condition; it includes asphalt, wood-block, and bithulithic. The rough granite block paving must be gone over twice, and here the machines must be slowed down to one mile per hour. During the day this district is patrolled by 60 men, as before, but this number may be reduced. The two machines cleaned the streets for nearly a year under contract, ending in June, 1917. The contract has recently been renewed for a year. During the first contract the machines were out of commission only 6 1/2 nights in 11 months.

Street Sprinkling Eliminated

A report on this work by C. M. Talbert, director of streets and sewers, in August, 1916, stated that the machines removed the fine and impalpable dust "which has been found by bacteriologists to be the germ-carrying part of street refuse." By cleaning every night, street sprinkling has been eliminated. This, in turn, lessens the skidding of automobiles on wet pavement. The use of the machines has materially reduced the labor required for cleaning sewer inlets and catch-basins. The material removed from these has been reduced about 35 per cent., and it is expected that the cost will be reduced about 50 per cent.

Mr. Talbert considers that a disadvantage of the machine is that it cannot be used except when the roadway and gutters are perfectly dry. During the rainy season, therefore, street flushing may be necessary. He states that no complaints of dirt in the congested district were received in the 60 days the machines were in use, and that merchants and others had expressed the opinion that conditions, so far as dust is concerned, had improved.

The Standard Slow Combustion Building*

By Alfred Kuhn

WHEN the construction of a commercial or factory building is being considered by the architect who wishes to protect his client in the matter of fire hazard, wood framing being considered out of the question, reinforced concrete seems to be the only alternative.

This is partly due to the mistaken idea that seems to prevail, especially to the layman, that any timber construction is hazardous, must therefore be tabooed, and is associated with the old type of joist constructed building—that old fire trap, with the open elevator hatchway and stair well, throughwhich the fire roared, spread from floor to floor and was soon beyond the control of the firemen; then falling walls and total destruction.

The fact of the matter is, that long before the present era of reinforced concrete, the very best type of brick masonry and wood frame structure was developed to the highest degree of fire retarding efficiency and which even today when it is properly designed and constructed will command a very low rate of fire insurance, the standard slow combustion building. It represents to my mind the best type of building for warehouses, factories or similar structures, when properly designed, in point of economy, time required in erection and simplicity of construction, and is especially good for factories that require mechanical equipment, on account of the easy manner that it can be installed, due to the heavy wood framing and open ceiling.

Insurance Cost is Low

The cost compared with the reinforced concrete building is greatly in its favor, considering the little difference in the insurance rating, the basic rate on the slow burning being 38 cents and on the concrete building 33 cents, with a reduction of 50 per cent. if the building is sprinklered.

In view of the fact that the admirable qualities of the standard slow combustion building have been somewhat overlooked, a few words on this excellent form of construction, considering the present steel situation, may be of timely interest.

Slow combustion, as applied to buildings used for commercial purposes, was developed from mill framing or mill construction (hence the name) where on account of extreme fire hazard it had been put to severe test and proved so effective, that its use was extended to wholesale houses, warehouses or similar buildings, with the framing modified, of course, to meet the various loads and requirements.

In the original mill construction the posts were twenty or twenty-five feet apart and beams eight to eleven feet on centers, according to floor load required; the carrying floor three inches thick or as needed, and spanning from beam to beam. The weight of the milling machinery was directly over the framing, the aisles in centre between spans, where very little load was required; an ideal floor construction for the purpose. Each floor was cut off from other floors, each compartment from other compartment or section, so that fire, often caused by spontaneous combustion or explosion, could be confined and not communicate from storey to storey, and every precaution was taken in the details of construction to prevent this. The floors were made waterproof to prevent damage by water to storey below and graded to wall scuppers so that it could drain off when the floors were flooded, or to elevator shaft when scuppers were not provided.

Adaptation of Mill Construction

These main essential details were retained when applied to commercial structures; the spans or bays,

*From Architect and Engineer of California.

however, had to be increased in width and length adjusted, requiring heavier girders and intermediate heavy framing of beams which were placed as far apart as the uniformly distributed floor loads would permit; the heavy carrying floor being exposed underneath made an extremely fire resisting ceiling with the heavy intermediate open framing, the main principle of slow burning, and far more pleasing in appearance than the exposed joist construction of the class C building.

No architect when planning a commercial building should apply, without a struggle for a better structure, that abominable type of fire trap, known as a joist constructed building; joists spaced twelve or sixteen inches apart and two or three inches thick which furnish many excellent projections and corners that ignite easily and burn like tinder, especially if sealed underneath, the space between the joists forming pockets where the fire lodges and is so hard to extinguish until the floor burns through. A slight fire would burn each surface of the joist and make it useless as a floor support, whereas on the other hand the same fire would not affect the heavy floor and timber construction in the slightest degree. I have the interior of a slow combustion building in mind that had been subjected to a quick hot fire, where the timbers had only slightly charred on the surface and all framing not disturbed in any way; the same fire in a joist constructed building would have caused the floors to burn through and spread.

Double Girders Expose More Surface to Fire

In early examples of slow burning structures, when floors were heavily loaded, it was common practice to make the girder in two pieces bolted together with one inch space between, allowing quicker seasoning and providing better ventilation for the timber, to prevent dry rot. This form was, however, soon discarded as more surface was exposed to the fire which lodged in this space, often preventing its extinction and causing the floors to collapse.

In the best practice a standard slow combustion building should have a floor area not to exceed 5,000 feet per fire section unless equipped with a standard sprinkler system; by fire section is meant a portion of the building cut off by standard fire walls, preferably brick. The height of the building should not exceed 65 feet above the average grade level and no storey to be over 15 feet in height; the basement is considered a storey if the distance between the bottom of the overhead girder and the average ground level exceeds three feet. The floor areas can be increased when sprinklered, also height of building, an eight storey building being about the maximum for height.

Eliminating Fire Hazard

All stairways and elevator enclosures must be of brick or concrete, and all openings to same provided with standard fire doors with fusible links and self-closing, to prevent fire communicating from floor to floor, and all exterior openings exposed to fire hazard from adjoining buildings must have metal frames and wire glass, or fire shutters of standard make, metal covered

It is essential that the best protection be provided to guard against fire entering a building, a point that is often overlooked or disregarded on account of expense, and because of the general practice of this false economy many buildings are often gutted and their contents destroyed, metal frames and wire glass afford the best protection, as fire shutters are as a rule always open when an adjoining fire threatens. Of course, we all know that there is no such thing as a fireproof building in a conflagration, nor will anything save a structure so exposed, but every means should be taken to check the fire—make the building as fire-resisting as possible; because such precautions are not the general rule valuable surrounding property is destroyed annually which otherwise could have been saved.

High Grade Timber Necessary

In the slow combustion building, one of the most important items is the kind and quality of lumber, and for the framing timbers a grade should be used that possesses high strength values, composed of strong, dense fiber and free from all defects which would render it unsatisfactory for durability or strength; selected structural Douglas fir timbers meet all these requirements.

The posts must have a sectional dimension of not less than 64 square inches, superimposed throughout all stories on metal caps pintle and base plate; the caps receive the beams and girders. Various good forms of steel caps are on the market, although cast iron caps are often used to good advantage and can be designed to meet exact requirements. Posts should be ventilated to prevent checking and to guard against dry rot.

Beams resting on walls are received in metal wall boxes, with sufficient space around the end of timber to allow circulation of air, and so designed that in falling the ends will be self releasing and not damage the wall; the beams are supported at the girder with wrought iron stirrups, or hangers, malleable hangers are to be preferred as they have been subjected to severe tests in various fires and are not affected by excessive loads.

Strength of Hangers

Several years ago at the Washington University in St. Louis various types of hangers and stirrups were tested, and the best type of malleable hanger failed at 39,550 pounds; a single wrought iron stirrup 3/8 by 2½ inches, however, sustained a load of 13,750 pounds before failure took place. The strap or stirrup hanger will take care of all ordinary requirements, but I prefer the Duplex hanger for strength, and its simplicity of design permits it to be placed quickly; the holes that receive the spools do not weaken the girder, which has been proven by actual test, and another great advantage that it has, the effect of shrinkage is reduced and it eliminates any cutting of beam or flooring that is necessary when the other type is used.

The carrying floor should be not less than three inches thick and covered with two layers of building paper, the bottom layer well mopped with pitch, and flashed at least three inches in height on all wall lines to make floor watertight; the floor is graded to wall scuppers or other outlets so it can drain off when flooded. On top of this floor the wearing floor is well nailed and made as tight as possible. At each floor level where there is no offset in the wall, corbel out with a ledge, which acts as a fire stop and prevents fire communication.

Cold Water Paint Permits Seasoning

As a rule, 10 per cent. moisture is permitted in all framing timber, and for this reason no oil paint, or varnish, must be used until the wood is thoroughly seasoned, as this prevents evaporation and fermentation of unseasoned wood (dry rot) often takes place; cases are on record where entire buildings have collapsed from this cause. If painting is required, cold water paint is permissible; this will not prevent the wood from seasoning, which ordinarily takes about three years, depending on the amount of moisture it contained when placed in the building; oil paint, or varnish should not be used under any circumstances, as it would make the woodwork highly inflammable and defeat the main and important object of slow combustion construction, which is fire-retarding.

Mainly Constructional

East and West—From Coast to Coast

The Good Roads Committee of the Council of Elgin County, Ont., have been making an inspection of the county's roads.

The roofing of the new Masonic Temple in Toronto has now been completed. It is hoped that the building will be ready for occupation by the beginning of 1918.

The Nova Scotia Government have recently issued a proclamation bringing into effect the provisions of the new provincial roads act relating to the collection of funds and the organization and powers of the board.

The Canadian Northern Express Company will build an office building on Mansfield Street, Montreal, at a cost of $58,000. The structure will be 1½ storeys, 100 ft. x 79 ft., of solid brick construction. R. Rigby is the contractor.

Two large factory extensions are included in building permits issued recently in Hamilton, Ont. These are for the American Can Company and the Steel Company of Canada, each of which firms contemplates an expenditure of $75,000.

The good roads committee of the Hamilton Board of Trade at a recent discussion of the proposed highway from Hamilton to Owen Sound, decided in favor of the direct route between these two cities, as against the one by way of Orangeville.

There is a large increase in the number of permits for dwellings issued in the city of Toronto this year over 1916. Up till the end of September the city architect had issued permits for 700 dwellings, valued at $1,787,445, as compared with 436 for last year, when the value was $1,218,850.

Building permits issued in the city of Welland, Ont., in the month of September this year amount to $21,800, as compared with $12,905 in the same month in 1916. The total for the first nine months of the year is $205,180, as against $159,198 during the corresponding period last year.

Vancouver's building permits for the month of September number 47, and are valued at $36,990. For the same month last year there were 40 permits issued, at a value of $415,350. The total for the first nine months of this year is 406 permits, valued at $422,910, as compared with 336 in the corresponding period in 1916, valued at $1,631,744.

There were 128 permits issued in Montreal at a value of $250,958 in the month of September, as compared with 146 permits valued at $205,456 in the same month last year. A total of 1,300 permits were issued in the first nine months of the year, at a value of $3,852,665, while during the corresponding period last year the total was 1,498 permits, valued at $3,787,010.

There were 74 building permits issued in the city of London, Ont., in the month of September, at a value of $59,395, as compared with 81 permits, at a value of $39,710, in the same month last year. The total for this year up to the end of September is 672 permits, valued at $574,830, while for the corresponding period last year there was a total of 821 permits, at a value of $732,425.

Reeve Carter, of Simcoe, Ont., has started a movement in the council with a view to lowering the water rates, the tariff set when the system was installed not having been altered. A committee was appointed to report on the matter. The town engineer has been instructed to proceed with the preparation of a report on a surface drainage system for the whole town, in order that any permanent roadways put down will not have to be torn up shortly after being laid.

A short course in highway economics (construction and maintenance), under the direction of the Ontario Highways Department, was recently opened at the Ontario Agricultural College. Mr. W. A. McLean, Deputy Minister of Highways, was present, and Mr. C. R. Wheelock, of Orangeville, president of the Ontario Good Roads Association, delivered the opening address, touching on the ancient roads laid by the Romans and leading up to modern methods of construction. Students in attendance at the college are eligible for this course.

An application by the Toronto-Hamilton Highway Commission for an apportionment of the cost of the three new bridges at Mimico Creek, Etobicoke and Port Credit, was recently heard before the Ontario Railway and Municipal Board. The counties of York and Peel had raised objections to the cost of the new structures. Chairman McIntyre ruled that the decision as to whether the bridges should be of concrete or steel rested entirely with the commission. Following their decision in this regard, the board will give an order accordingly, and a further order for the apportionment of the cost to each municipality.

Personals

Mr. R. S. Gourlay has had his term as Toronto harbor commissioner extended, by an order-in-council by the Dominion Government, for a further period of three years, from October 22, 1917.

Mr. C. C. Ballantyne, of Montreal, has been sworn in for the portfolio of Minister of Public Works in the Dominion Government. Mr. Ballantyne has been vice-president and general manager of the Sherwin-Williams Paint Company since 1911.

Lieut. J. H. Ramsay, a graduate in science from Queen's University, Kingston, and a post-graduate of Cornell, has been awarded the Military Cross. Lieut. Ramsay enlisted with the Canadian Engineers early in 1916. He is a son of Rev. Dr. D. M. Ramsay, of Toronto.

Mr. L. V. Rorke has been appointed to succeed the late George B. Kirkpatrick as Director of Surveys for the Province of Ontario. Mr. Rorke has been acting Director for the past two years during Mr. Kirkpatrick's illness. He has had a long and varied experience both in inside and outside survey work, and is eminently fitted for the position. Mr. Rorke's appointment will assuredly be popular among Ontario surveyors and those connected with the department.

Obituary

Mr. William H. Hoskin, for many years a well-known builder and contractor, of London, Ont., recently passed away. His death was quite sudden and unexpected.

Lieut. Frank Quinlan was killed in action on September 29. He was the son of Mr. Hugh Quinlan, Westmount, of the firm of Quinlan & Robertson, contractors, Montreal, and was engaged as an engineer with the firm. Prior to enlisting he was at work on the G. T. P. shops at Transcona, Man. Lieut. Quinlan joined the 5th Pioneer Battalion under the command of Lieut.-Col. H. R. Lordly, and at the time of his death was engaged in railway construction work.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Amherstburg, Ont.
Town Council contemplate the construction of reinforced concrete pavements and cement curbs costing $12,000 on Apsley, Murray and Dalhousie Streets. Clerk, A. J. Burns.

Chapleau Township, Ont.
By-law will be submitted for addition to pump station and equipment costing $6,000 for the Town Council. Clerk, W. A. Mitchell.

East Oxford, Ont.
Plans and specifications with the engineer, F. J. Ure, Woodstock, and the clerk, F. G. Jackson, Oxford Centre, who will receive whole or separate tenders until October 15 for work and delivery at Currie Station of 2,500 feet of 10-inch tile and 1,150 feet of 12-inch tile for the Township Council. Tenders to state delivery can be made.

Goderich, Ont.
Town Council contemplate the construction of sanitary sewers costing $3,000. Clerk, L. L. Knox.

London, Ont.
Plans are being prepared for sanitary sewers costing $18,000 on Eva, Florence, York and Eleanor Streets. Engineer, H. A. Brazier.

Ottawa, Ont.
The Department of Public Works, Dominion Government, contemplate the construction of asphalt macadam pavement on St. Patrick St. from McKenzie to Printing Bureau. Deputy Minister, J. B. Hunter.

Port Colborne, Ont.
By-law will be submitted for cement sidewalk on Different Street costing $15,000 for the Town Council.

Regina, Sask.
City Council contemplates re-paving of Dedwney St. Mayor, W. D. Cowan.

Sherbrooke, Que.
The Waterworks Department, City Council, contemplate the installation of a filtration plant. Engineer, Thos. Tremblay.

St. Thomas, Ont.
The City Council will erect a $7,500 sewage disposal plant.

Simcoe, Ont.
Town Council has instructed the engineer, G. R. Marston, to prepare report on drainage system. Clerk, W. C. McCall.

Toronto, Ont.
Tenders are being received until October 16 for Moore Park drainage system, eastern and western sections, outlet via Glen Road, from Park Drive to Summerhill Avenue, for the Board of Control, City Hall. Plans, etc., at room 6, City Hall. Secretary, Thos. McQueen.

West Oxford Township, Ont.
Plans and specifications with the clerk, B. G. Jenvey, R. R. No. 5, Ingersoll, who will receive tenders until October 29 for the construction of a tile drain for the Township Council.

CONTRACTS AWARDED

Amherstburg, Ont.
Wm. Brennan, 100 Melrose Ave., Hamilton, and Wm. Hollingsworth, 15 South St., Hamilton, have the contract for the supply of concrete pipe in connection with waterworks, etc., for the Brunner Mond Co.

Madoc, Ont.
Quinlan & Robertson, Montreal, Que., and Crookston, Ont., have the general contract for one mile of waterbound macadad roadway on St. Lawrence Street for the Village Council and Provincial Government Highways Department.

Maidstone Township, Ont.
The following contracts have been awarded by the Township Council:—Drains, Stephen Conroy, Harry Pempraise, D. G. Montgomery and Wm. Robinson; cement bridges, Harry Pempraise and Jos. Quinlan; bridge and breakwater at King Tap, W. G. Taylor. Address contractors, care of clerk, A. Mousseau, R. R. No. 1, South Woodslee.

Railroads, Bridges and Wharves

Oshawa, Ont.
The Department of Public Works, Dominion Government, will start work at once on wharf. Engineer, J. M. Wilson.

Whitby Township, Ont.
Township Council contemplate the erection of a $5,000 bridge. Clerk, D. Holliday, Brooklin.

CONTRACTS AWARDED

Dundas County, Ont.
The following contracts have been awarded in connection with the erection of bridges for the County Road System:—F. M. Egleson, Winchester, 6 bridges, cost $12,000; H. J. Walker, Cornwall, 6 bridges, $12,000; Ontario Bridge Co., Ltd., Toronto, 2 bridges, $10,000; D. McRae, Finch, 2 bridges, $2,000.

Montreal, Que.
H. P. Booth, care of owners, Longue Pointe Branch, has the general contract and the Structural Steel Co., Ltd., 10 Cathcart St., the steel contract for $23,000 addition to running shop of the Montreal Locomotive Works, Dominion Express Bldg., who will carry out the carpentry, plumbing and heating. Prices are wanted on roofing, flooring and plaster work.

Oakbank, Man.
A. Powell, 203 Morley Ave., Winnipeg, has the general contract for a 60-foot and a 52-foot pile bridge for the Municipal Council of Springfield.

Ojibway, Ont.
The Great Lakes Dredging Company, Whalen Bldg., Port Arthur, have the general contract for docks costing $250,000 for the Canadian Steel Corporation.

Roberval, Que.
Moreau & Freres have the general contract and require 2,000 bags of cement for the construction of a $5,000 concrete dam for the Town Council.

Walkerville, Ont.
John Tinzel, 404 Buhl Block, Detroit, Mich., has the construction, and the Chick Contracting Co., McDougall St., Windsor, the material contract for $15,000 concrete dock for Hiram Walker & Sons, Ltd.

Public Buildings, Churches and Schools

Brockville, Ont.
The Redemptorist Fathers, 141 McCaul St., Toronto, have purchased a site on which they will erect a college.

Byron, Ont.
Tenders are being received for the erection of a $10,000 vocational school for the Government Hospital Commission. Architects, Watt & Blackwell, Bank of Toronto Bldg., London.

Lamont, Alta.
Plans and specifications with the architect, E. W. Morehouse, 304 Williamson Bldg., Edmonton, who will receive tenders until October 12 for the erection of a $9,000 addition to hospital for the Hospital Board.

Montreal, Que.
The general contractor, A. Champagne, 2185 Blvd. Pie IX., is receiving tenders for electrical work for $5,000 presbytery for Fabrique, St. Francois Solane, Jeanne d'Arc Ave. cor Masson and Dandurand Streets.

New Glasgow, N.S.
Tenders will be received until October 30 for the erection of a $30,000 nurses' home for the Trustees of Aberdeen Hospital. Plans and specifications with J. W. Carmichael & Co., George St.

Orillia, Ont.
By-law has been passed for the erection of a $75,000 hospital by the Town Council. Clerk, C. E. Grant.

Simcoe, Ont.
Wm. C. Tilley, Dalhousie St., Brantford, has been appointed architect, and tenders will be called soon for the erection of a $4,000 school for the Trustees Union.

Three Rivers, Que.
Tenders received by the secretary, R. C. Desrochers, Ottawa, until 4 p.m., Oc-

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Principal Contents

Flat Slab Construction Tested

ELSEWHERE in this issue appears an article by Mr. W. W. Pearse, C.E., city architect and superintendent of building, of Toronto, describing tests recently made on one of Toronto's new flat-slab concrete buildings. In recent years a number of such structures have been erected in Toronto. Up to the present, however, there have been no regulations in the civic building code governing this type of construction. On this account, therefore, designs based on American codes have generally been accepted, with minor modifications, intended, if anything, to ensure conservative designs. Ever since he assumed control of the City Architect's Department, Mr. Pearse has been watching the buildings of the flat-slab type erected in Toronto and elsewhere with a view to developing an ideal code that may be incorporated in the city's building by-law in the near future.

The codes, as formulated by the cities of the United States, are based on various theoretical considerations, and it has been within Mr. Pearse's scope of investigation to compare these codes and the buildings erected under their assumptions. It will be remembered that, in the Contract Record of January 17, Mr. Pearse, by synthetic methods succeeded in developing the theory at the basis of the Chicago code and proved it to afford an ample factor of safety.

Tests have recently been conducted by the City Architect's Department on a number of flat-slab buildings in Toronto, to determine the actual stress and deflection conditions under service loadings, with the object of comparing these with the theoretical stresses, as calculated from the codes. These tests embrace both two-way and four-way construction designed according to several different civic rulings. The article which is published in this issue, enlarges upon the experiments conducted at the plant of the William Davies Company, a two-way flat-slab design. The author has calculated the stresses in the concrete and steel by the Chicago, Philadelphia and Pittsburg codes and the Joint Committee recommendations, and compared these with the actual stresses as developed by test. Tables 1, 2 and 3 tabulate the comparisons and are really an epitome of the whole article.

Superficially, the tests do not give results comparable with the code rulings, but it was found that if the tension in the concrete—a factor usually neglected—is considered, the actual and theoretical stresses are reasonably similar. As the loading was not sufficient to develop cracks in the concrete where it was stressed in tension, tension stresses can safely be considered. By so doing, the actual conditions are not far removed from those which, from the codes, one is led to believe are present. Similar tests on other buildings will afford, no doubt, further interesting comparisons. These will be reported in the Contract Record from time to time and will unquestionably be of interest as throwing light on a type of construction that is largely yet a matter of mystery.

Royal Architectural Institute Holds Annual Meeting

MR. J. P. Ouellet presided at the tenth annual meeting of the Royal Architectural Institute of Canada, held at the Chateau Laurier, Ottawa. Both at the meeting of the Council and of the Institute there was not a quorum, but the members proceeded with certain items on the agenda. The delegates from the federated associations of architects to the 1917-18 Council were reported by Mr. A. Chausse, the honorary secretary, as follows: Alberta, Messrs. R. P. Blackey, Calgary, and W. D. Cromarty, Edmonton; Manitoba, Messrs. L. H. Jordan, Winnipeg, H. E. Matthews, Winnipeg, and J. H. G. Russell, Winnipeg; Ontario, Messrs. C. H. Acton Bond, Toronto, A. Frank Wickson, Toronto, and J. P. Hynes, Toronto; Quebec, Messrs. D. R. Brown, Montreal, Alcide Chausse, Montreal, J. P. Ouellet, Quebec, J. Perrault, Montreal, Herbert Raine, Montreal; the Saskatchewan nomination not yet received.

The question of the admittance of the Architectural Institute of British Columbia was discussed. The Council, it was stated, had passed a resolution admitting the B. C. Institute, provided that satisfactory evidence be forthcoming that the B. C. Association of Architects had been disbanded. It was explained that the two associations had previously claimed to be federated, and that there had been considerable correspondence on the subject.

It was also reported that the Council had passed a vote of condolence with the family of the late Mr. J. W. H. Watts, R.C.A., Ottawa, the honorary treasurer, and one of the founders of the Institute.

In his annual report Mr. Chausse reviewed briefly the history of the Institute, and the proceedings of the Council.

The balance sheet showed a balance of $935.40.

A letter from Mr. E. Burke, Toronto, was read, suggesting that in view of the probable number of public monuments which would be erected at the close of the war, the Institute might move in the matter of an appointment of an art jury to pass upon the proposed designs. If Government assistance, both federal and provincial, could be secured, making such jury or juries official and authoritative, it might be made still more effective. There would be great danger of abortions in the way of monuments if some artistic supervision were not provided. Mr. Chausse stated that he would write the provincial governments on the subject.

Competition Prizes

Mr. L. H. Jordan made a number of suggestions, to be taken up at a later date. These included the payment of cash prizes of $100, $75, and $50, to be offered in lieu of the gold, silver and bronze medals proposed, but that medals be struck off as soon as practicable and awarded to such candidates as prefer them. He also suggested that the suit against the Dominion Government in connection with competition prizes be carried on at the expense of the R. A. I. C., instead of by any one provincial association. The R. A. I. C. should offer its professional services to the Dominion Government for war purposes as an organization, either in consultation or by way of advice.

Papers were read on "Why the Practice of Technical Professions in Canada should be Regulated by Law," by Mr. J. P. Hynes; "Professional Ethics," by W. A. Langton; and "The Development of Architectural Design in Canada," by Mr. Alfred Chapman.

Save Gasoline!

THE national automobile organizations of the United States are carrying on campaigns for the conservation of gasoline wherever possible, and offer a number of suggestions which, though evidently axiomatic, are nevertheless frequently forgotten by the busy contractor. The same admonitions may not be out of place for Canadian operators who may have fallen into careless habits in this respect:

1. Do not use gasoline for washing or cleaning—use kerosene to cut the grease.

2. Do not spill gasoline or let it drip when filling—it is dangerous and wasteful.

3. Do not expose gasoline to the air—it evaporates rapidly and is dangerous.

4. Do not allow engine to run when car is standing. Most cars are fitted with self-starters, and it is good for the battery to be used frequently.

5. Have carburetors adjusted to use leanest mixture possible—a lean mixture avoids carbon deposits.

6. See that piston rings fit tight and cylinders hold compression well. Leakage of compression causes loss.

7. Stop all gasoline leakage. Form the habit of shutting off gasoline at the tank or feedpipe.

8. See that all bearings run freely and are well lubricated—friction consumes power and wastes gas.

9. Protect the radiator in cold weather—a cold engine is hard to start and is short in power.

10. Keep tires fully inflated — soft tires consume power.

11. Do not drive at excessive speed. Power consumption increases at a faster rate than speed. Every car has a definite speed at which it operates with maximum fuel economy.

12. Change gears rather than climb hills with wide-open throttle—it saves car and gas.

13. Do not use cars needlessly or aimlessly.

Canada's First Model Town

The model town contemplated by the Riordon Pulp and Paper Company, near Temiskaming, Ont., as mentioned in the Contract Record of October 3, will be the first of its kind in Canada. Further details are contained in the current issue of Conservation, the organ of the Commission of Conservation, as follows:

A splendid site overlooking Lake Timiskaming has been laid out according to modern principles of town planning by the Commission of Conservation, through its Town-planning Adviser, Mr. Thomas Adams, who has acted as consulting engineer. Building operations will be started shortly by the Riordon Pulp and Paper Company, who are to erect a large sulphite mill and paper plant nearby and for the accommodation of whose employees the town is intended.

Easy Grades

A contour map showing the levels of the site was first prepared and the streets were then laid out so as to secure easy grades, directness of route, and absence of sudden deflections. If the usual method of rectangular survey had been adopted, the most important streets would have had grades of from 10 to 18 per cent., but, under the plan, the maximum grades have been reduced to 3 and 5 per cent. in most cases, with a maximum of 8 for short lengths.

Before any buildings have been erected the line of each street has been blazed through the forest so as to fix the best street locations and to secure the best aspects for the dwellings. Areas are being set aside for open spaces, social centres, churches, schools, etc., in advance. The main approach to the town will be by a street, 80 feet wide, passing through a square on which the stores and public buildings will be erected.

It is proposed to make the town a model of its kind, as it is recognized by the promoters that healthy and agreeable housing and social conditions are of vital importance in securing efficiency of the workers, and that large employers of labor have a direct responsibility in providing proper living conditions for their workers.

Mining Thin Coal Seams

The Department of Mines, Ottawa, has recently published a bulletin under the title, "The Mining of Thin Coal Seams, as Applied to the Eastern Coal Fields of Canada," which outlines the problems involved in the mining of these coals. The descriptive, technical and cost data are of great interest to the mining profession and to those who have at heart the economic development of the coal resources and industry of the Maritime Provinces.

Regulation of Professional Practice

Architects at Meeting of R. A. I. C. Discuss Architectural Education and Legal Restrictions to Prevent Practice by Aliens

By J. P. Hynes

THE questions of architectural education and of legal restrictions on the right to practice architecture have agitated the architects of the English-speaking world for more than a generation. Today the question of a college educational course is practically conceded on all sides, while the question of legal restrictions is slowly taking form in actual legislation in at least ten States in the American Union and was before the Imperial Parliament when war broke out. In Ontario ten years ago these questions were discussed with considerable feeling, and for the time settled in favor of promoting education and dropping legislation, the expectations being that the educational institutions would then fulfill the reason of their existence and supply the province with trained men to handle its problems. However, the constant and growing usage of alien architects erecting most of the larger commercial buildings of the province has raised the whole question again, and the following is an attempt to state the present situation and point to its remedy.

Alien Architects Have Practised for 35 Years

On investigation, it was found that alien architects have for at least the last thirty-five years almost continuously practiced in Ontario on a large number of important buildings, as may be instanced by the following examples:—

Starting with the Western Assurance Company building in Toronto, there has followed in almost continuous succession, the Canadian Bank of Commerce, Toronto; the Bank of Hamilton, Hamilton; the Ontario Parliament Buildings, Toronto; the Toronto Board of Trade, the Bank of Hamilton Building, Toronto; the Bank of Toronto Building, Toronto and St. Catharines; the Imperial Oil Company's building, Toronto; two buildings for the Robt. Simpson Company, and three for the T. Eaton Company in Toronto and one in Hamilton. At the present time there is under construction or about to be erected in Toronto, the T. Eaton Company warehouse; the T. Eaton Company's Departmental Stores, the Wm. Davies Company abattoir, and buildings for the Brown Brass Company, the Goodyear Tire Company, the proposed Devonshire Hotel and several theatres; while throughout the province there are the International Nickel Company's buildings, Port Colborne; the Dominion Government Arsenal, Lindsay; Dominion Government explosive factory, Renfrew; Dominion Government explosive factory, Trenton.

The effect on the resident architects is that it is depriving them of the opportunities that the province naturally affords them, and which, if they enjoyed, would bring them such recognition that there would be little thought of bringing aliens into the province.

Discourages Young Men

The effect on the practice of architecture in the province is to discourage the resident practitioners and drive the young men graduated from the University, from the province, and create a strong tendency to a low standard of practice by introducing unfair competition, as very frequently the alien practitioners practice on a purely commercial basis even to the extent of association with the contractor in such a way as to make it appear to the client that the architects' services are of such little consequence that they are thrown in by the contractor.

Through the personal agitation of a number of architects and builders, considerable comment on the number of alien architects practising in the province appeared in the papers, noticably the trade journals, and was eventually discussed at an executive meeting of the Toronto branch of the Canadian Manufacturers' Association. This led to an interview between the president of the above association and the president of the Ontario Association of Architects, after which the former, on behalf of his association, convened a meeting of representatives from the Toronto Branch of the Canadian Manufacturers' Association, the Ontario Association of Architects, the Toronto Branch of the Canadian Society of Civil Engineers and the Toronto Builders' Exchange.

After considerable discussion it was determined to jointly memorialize the Dominion Government, to bring to its attention the extent to which alien architects and contractors were doing business in Canada and that even the Government itself had given the erection of the new arsenal at Lindsay to aliens, and a memorial was prepared for presentation to the Government.

Memorial to Government

In drafting this memorial, many suggestions were deliberated upon; some were realized to be impracticable and others were deemed inefficient, as may be illustrated by the two following cases:—

It was considered that if there was the same legislation to prohibit American architects practicing in Canada as there was thought to be prohibiting Canadians practicing in the United States, it would be a satisfactory method of control. Upon direct correspondence with Washington it was learned, however, that the legislation restricting aliens entering the United States excepted members of the learned professions and that the Department of Emigration at Washington had ruled that any architect while residing in his own country and holding a certificate of graduation from a recognized university or of good standing in a recognized society of professional architects, might practice in the United States subject to state license and registration laws. It may be observed in passing, however, that this permission extends only to the individual who is a member in good standing, and not to his staff of employees.

The other was to control the practice by customs duties, and was discussed with the Customs Expert of the Canadian Manufacturers' Association. The present duty is $22\frac{1}{2}$ per cent. plus a war tax of $0\frac{1}{2}$ per cent. on 4 per cent. of the cost of the building, which is evidently too low to act as a deterrent on the employment of alien architects, and is easily avoided. A duty high enough to be a deterrent was deemed impracticable to obtain or administer, as well as being too easily subject to change. The duty on architectural drawings has been in several different forms in the past few years.

Legislation controlling the practice of architecture has been in force in Quebec for twenty-six years, and more recently in Manitoba and Saskatchewan, and in ten of the United States. Starting with Illinois in 1900, New Jersey, California, New York, Utah, Florida, Colorada, Michigan, Louisiana, and North Carolina have since adopted some form of license or registration for architects.

It is understood that many architects in the States, where license laws are in force, are disappointed at their lack of effectiveness in improving the status of the practice of architecture, and that the advancement in that direction was more attributable to the increasing number of architects who took university courses of training. It is also evident that the Quebec, Manitoba and Saskatchewan Acts have not been effective in protecting resident architects in their respective provinces from undue alien competition.

The model for such legislation before the Ontario Legislature would undoubtedly be the Ontario Medical Council Act, which licenses medical doctors to practice in Ontario, but the experience of the Ontario Association of Architects ten years ago and graduate nurses and others that have since sought legislation on these lines, indicates that the objection that such legislation is close corporation legislation would defeat any effort on these lines, as there is not sufficient parallel between the practice of medicine and architecture to ask that legislation similar to that given to the doctors be given to the architects.

It is primarily for the protection of the public that the doctors are licensed, and there appears to be no better way, as doctors must act instanter. The public, however, are most effectively protected in their relations with architects by laws on sanitation and construction, and it is no hardship to the architects to practice under these laws.

Standard of Qualification

Out of this question of licensing arises the question of a standard of qualification which should be required for the practice of architecture, or in other words, what standard of education should be required? The standard of education today is not that of a certificate from an examining or licensing board, but that of a course in architecture in a recognized university, and from this arises the question, "Whose duty is it to provide the university course?"

This was found in the principle put forward at the time that the Ontario Association of Architects withdrew its bill for licensing in deference to the contention of the University of Toronto that to license by examination without a course of tuition could set up a low standard of education for architects in Ontario and at the same time be detrimental to the advancement of the university courses in architecture.

"The principle was that as the province needs men of training to handle the problems of the community, it devolves upon the province to provide the means by which such training may be obtained."

That the province admits its responsibility in this is evidenced in fact by its whole educational system, but especially by its higher educational and university courses.

Public Has Confidence in Some Professions

In looking into the status of the various professions trained in these courses in this province, namely, medicine, law, dentistry, pharmacy, pedagogy, veterinary, surgery, engineering in its many branches, architecture, chemistry, and in the many other branches of technology it was observed that medicine, law, dentistry, pharmacy and pedagogy enjoyed the confidence of the people of the province, even to the extent of a pronounced pride being evidenced by the public that not only was the rank and file of these callings of a high standard, but that many in them attained to eminence in their professions, and it was also observed that the people of the province did not resort to non-resident and alien practitioners in these callings. The legislative restrictions accounted directly for the latter and indirectly for the confidence and pride the public evince.

Architects a Less Favored Group

It is evident that in a province like Ontario there is sufficient practice in every one of the professions named for men of ability to attain distinction, and that in those professions that had the opportunities of the province conserved for them many men of distinction were constantly in evidence, but that in such professions as did not have the opportunities conserved for them, the men of distinction were not so numerous and that the alien practitioners were always evident. Examining the situation under that light, it became evident that architects are one of the less favored group and that their grievances are shared by all practitioners of technology.

The conclusion evidenced by the above is that the Government, to attain the object of its higher education in technology, namely, to provide the province with men of training to serve the community and in whom the community may have confidence and pride, must conserve the opportunities of technical practice that develop in the province for the resident practitioners of such technical work.

It develops into a choice of raising the practitioners of technology in the province to the high standard that the educational facilities now provided by the province for them, would, under favorable conditions, permit them to attain and which have been attained in the professions that have their opportunities conserved for them, or, of having these educational advantages in technology and the opportunities for technical practice of this province exploited by students taking the course provided in this province and immediately departing to devote their energies to other communities, and by aliens, non-resident and untrained technical practitioners exploiting the technical opportunities of this province.

A Country's Resources for Its Own Benefit

To allow the present conditions to persist is a flagrant breach of the economic principle that a country should develop its manhood and material resources for its own benefit rather than for the benefit of aliens. In a word it may be stated that it devolves upon the province not only to provide the means to train men to serve the communities' need in technical work, but to make that training effective; it also devolves upon the province to conserve the opportunities in the practice of technology in the province for the resident practitioners.

This may be done by the Government establishing in the Department of Education a registrar who shall register all present resident practitioners in technology, all graduates in technology from the universities of the province and such others who on becoming residents of the province comply with the provisions set out in an act which would control in this province the practice of technology in all its branches.

The advantages of legislation on these lines is that it keeps the control entirely in the hands of the Educational Department of the province and at the same time make the educational facilities of the province efficient in results as they now are in training.

It eliminates all professional boards of examination or license and maintains but one standard of education on which to practice, namely, a recognized university course.

Discussion

A long discussion followed. Mr. A. F. Wickson said that Mr. Hynes' idea seemed to be that if there were a School of Architecture in the universities, and if the Government were to legislate, the only people who could practice in Ontario would be those passed by that Board of Education, and not by a Board of Architects, or some outside body, which would largely tend to obtain the ends desired. Some Toronto architects were convinced that the only way for a young man to study architecture was through a university course. Mr. J. P. Ouellet said this was the practice in Quebec.

Mr. Wickson said he agreed that the examinations should be in the hands of the educational authorities of the province, and that the work of carrying out the act should be in the hands of the Government. Mr. Hynes was fully converted to the view that there was no encouragement for a young fellow trained in architecture to stay in Canada because the aliens came in and got a great deal of the work without any restriction. Mr. J. A. Pearson asked how this could be prevented.

Mr. Smith replied that the Government of the province or of the country should make it impossible for the alien to come in. There should be some arrangement to prevent young men of ability going to the United States. Mr. Pearson said this could not be prevented. The only step that could be taken would be to penalize an architect living in the United States who came to practise in Canada.

How Prevent Aliens Coming Here?

Mr. Jordan remarked that Mr. Hynes' suggestion would perhaps have a tendency to raise the standard of architects admitted to practise here, but how could they prevent alien architects coming here?

Mr. Wickson pointed out that architects from New York went to Chicago, and it seemed impossible to enforce the principle that the architecture of a place should be done by its own men.

Mr. Smith referred to the feeling of clients who went across the border for architects who perhaps had specialized in certain classes of building, on the ground that they obtained better value for their money. This could only be overcome by education. Something could be done in the way of legislation to prevent the inefficiently trained architect from practising.

Mr. Wickson said that Mr. Hynes' idea was that if all the architects practising in Canada were properly trained men it would raise the standard of the profession, so that the importation of alien architects would automatically cease. With that view, it would be a good thing to get the Government to become a little more active.

Mr. Ouellet said that was the only practical way of stopping the alien from coming in. The Quebec Act provided that any architect practising in the province had to register, and if he were a member of some recognized association in his own country the Quebec Association was supposed to take him.

Duty on Plans

Mr. Chausse stated that if the architect brought plans from the United States the duty had to be paid.

Mr. Wickson: The duty is 22 per cent. of one per cent.

Mr. Pearson: That is a wrong basis. It should be 25 per cent. of the commission he receives.

Mr. Smith: Then he either forfeits that proportion of his commission or the client has to pay more for the service.

Mr. Pearson argued that if a man came from the United States and opened an office in Canada there should be some deduction from what he would have to pay on that account; his overhead, draughting and office expenses should be taken into consideration. If a man came in and simply opened an office without doing any of his work in this country, he should pay at least 25 per cent. of the 5 per cent. commission.

Mr. Wickson said the American law was different from ours. They allowed a Canadian architect to go there and practise, but he could not take his staff with him nor send anybody else as a substitute. If he had any work in the United States he must do it himself. The Canadian architects did not have protection from the United States. There were buildings in Toronto which, as far as he knew, the architects never saw. The plans were made in the States and sent up in charge of a head draughtsman who simply opened an office. On the other hand, Ross and Jennings had some difficulty in the States. They obtained a contract there but could not take a single man in with them; they had to hire all their men there.

Mr. Jordan suggested that this difficulty could be gotten over by sending in a staff one by one, and engaging them in the States. While one could not make a contract in Canada with men to work in the States there was nothing to prevent a firm employing them when they got there.

Mr. Pearson thought that information on the points might be obtained from the Customs, but Mr. J. P. MacLaren answered that little help was to be expected from that quarter.

The following contracts have been obtained by Mr. G. B. Reynolds, Montreal, agent of the Trussed Concrete Steel Company of Canada, Ltd.: 24-gauge 7-rib hyrib for the Parliament Buildings, Ottawa; reinforcing steel for the retaining wall and Express building, Mount Royal Tunnel & Terminal Company, Ltd.; reinforcing steel for skeleton of addition to Ottawa dairy, Ottawa (contractor, A. Garvock); design and supply of reinforcing steel for motor building owned by Mr. R. Blackburn, Ottawa; reinforcing steel for filtration plants at Dorval, P.Q. (contractor, A. Bastien), St. Johns, Que. (contractors, Laurin & Leitch), and Pointe Claire, (contractors, Arsenault and Plamondon).

Flat Slab Codes Compared with Tests Carried Out on Toronto Building

Actual Stresses as Determined by Experiment Do Not Coincide with Those Developed from Codes Unless Tension in Concrete is Considered

By W. W. Pearse, C. E.[*]

THE city of Toronto has no building code to govern the flat slab type of construction, and as a number of large buildings have been erected by this method, it was necessary for the City Architect's department to give a ruling as to what American codes would be allowed. Up to the present time I have passed those of Chicago and Philadelphia, and structures have been designed by these two methods. Upon an examination of table No. 1 in the following article it will be noted that there is really very little difference between the two by-laws when they are compared on a common basis.

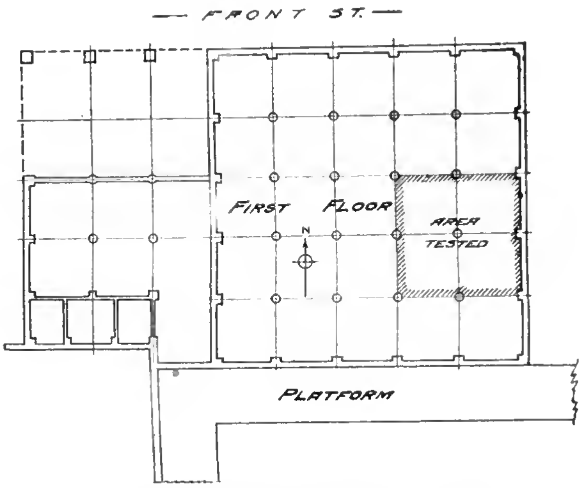


Fig. 1—General plan of building showing area tested.

The article is based on tests made on the reinforced concrete building of the William Davies Company, Limited, of Toronto, and as noted elsewhere, the structure is designed in what is commonly known as the two-way flat slab type of construction. I have endeavored to compare the codes of Chicago, Philadelphia and Pittsburgh, also the regulations proposed by the Joint Committee on Concrete and Reinforced Concrete, with the actual stresses which were measured by extensometers. From a first observation it would appear as if none of the codes gave results that would in any way compare with the actual tests, but if the actual conditions were taken into consideration, such as the tension in the concrete, I found that they all gave a very fair comparison with the actual test as far as we had sufficient readings to go by. The steel at the column cap agreed approximately and the concrete was within fair bounds. The centre part of the slab could not be compared very well, due to the fact that the concrete readings were not taken immediately above the steel readings and, therefore, the neutral axis of the sections could not be arrived at.

It is evident from the very nature of things that the comparisons must always vary considerably, due to the utter impossibility of being able to get two batches of concrete the same mix, etc.; therefore the modulus of elasticity will constantly vary at different sections. As pointed out in the discussion, no test was made to arrive at the modulus of elasticity of concrete in tension. It has been the common assumption that the concrete has the same modulus for either tension or compression, but Johnson's "Materials of Construction" gives a number of tests, and he states that the ratio is 7:10. I have taken it as 8:10, taking, as a basis for compression, 3,000,000 pounds, whereas the tests warrant anywhere from that figure to 3,500,000 lbs.

One test is not sufficient evidence on which to base any theory, but as I have a number of other tests on which I am working, the results of these may throw additional light on the subject.

Mr. T. D. Mylrea conducted the tests and Mr. W. A. McM. Cook, of the City Architect's Department, carefully checked over all my work.

William Davies Building

The method of construction used in the William Davies building, described in the Contract Record of March 14, 1917, is the two-way flat slab, drop head, reinforced concrete system, briefly known as the "two-way system," and the following discussion will be so designated.

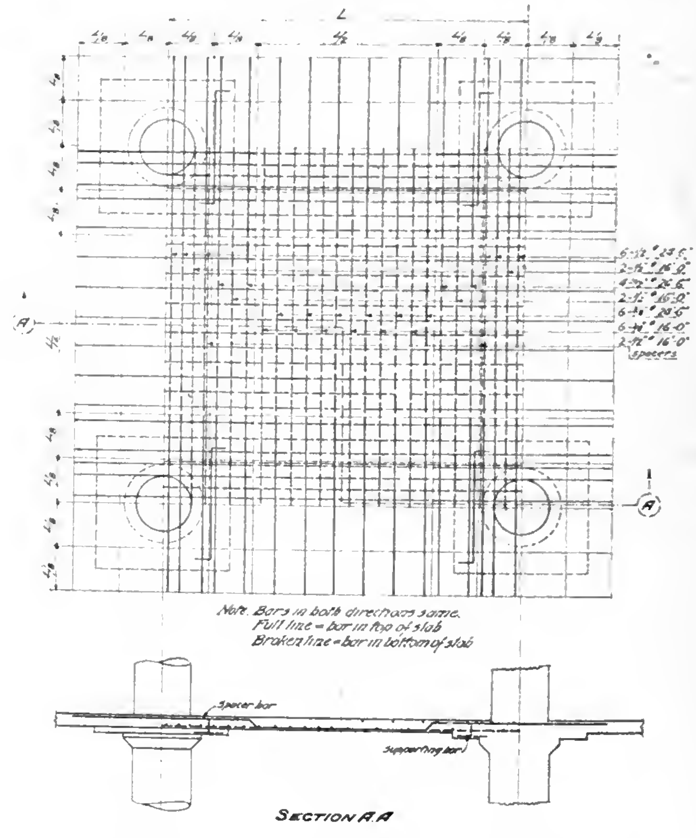


Fig. 2—Typical panel, showing details of reinforcement.

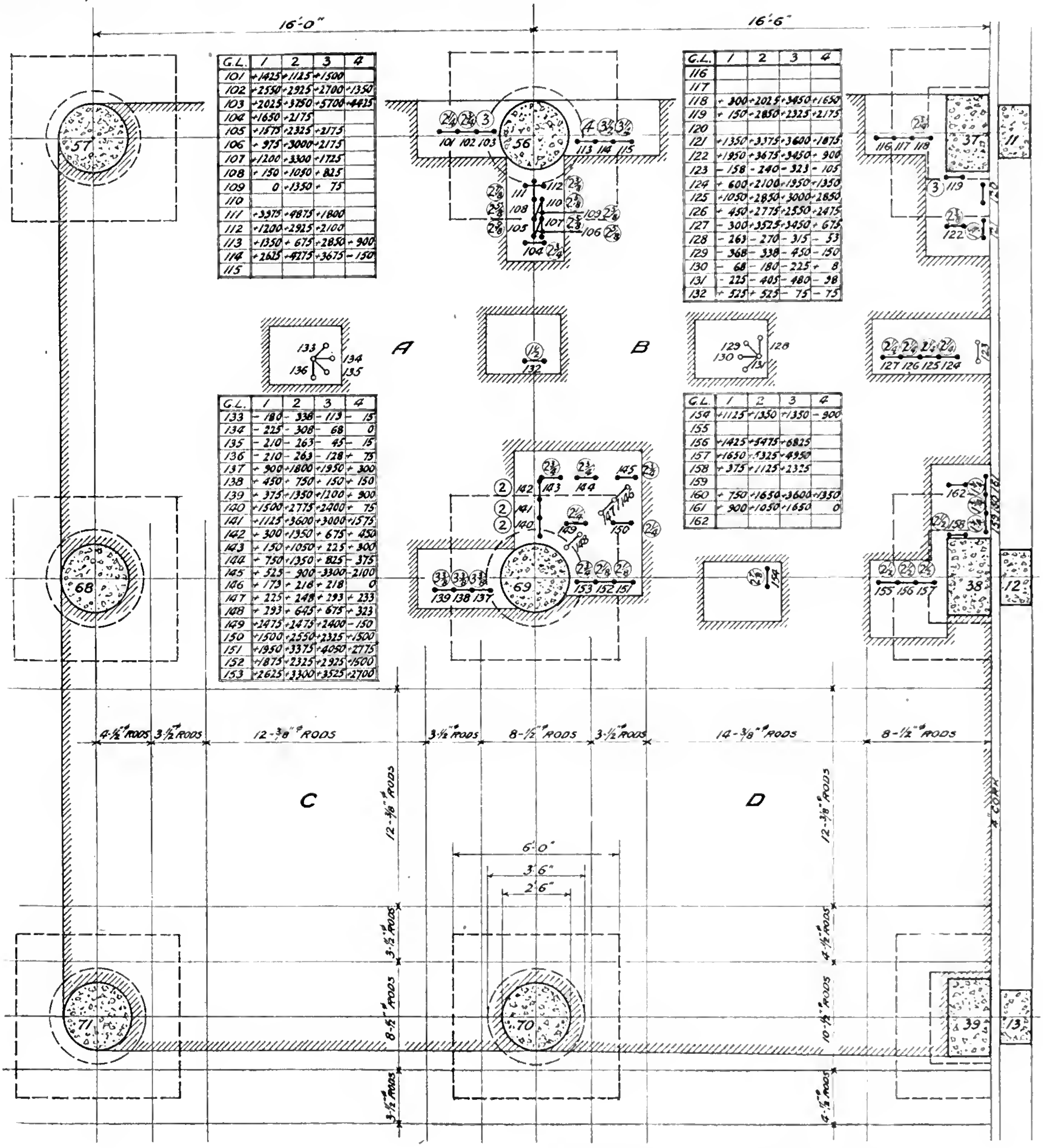
A comparison will now be made of the stresses found by the actual extensometer tests and those found by applying the different city by-laws.

The first by-law to be considered will be the Chicago Code. Following is the notation:—

L = Distance centre to centre of columns in feet.

L_1 = Distance edge to edge of heads of capitals in inches.

[*] City Architect and Superintendent of Building, Toronto.



G.L.	1	2	3	4
101	+1425	+1125	+1500	
102	+2550	+2925	+2700	+1350
103	+2025	+3750	+5700	+4425
104	+1650	+2175		
105	+1575	+2325	+2175	
106	+ 975	+3000	+2175	
107	+1200	+3300	+1725	
108	+ 150	+1050	+ 825	
109	0	+1350	+ 75	
110				
111	+3375	+4875	+1800	
112	+1200	+2925	+2100	
113	+1350	+ 675	+2850	+ 900
114	+2625	+4275	+3675	− 150
115				

G.L.	1	2	3	4
116				
117				
118	+ 300	+2025	+3450	+1650
119	+ 150	+2850	+2325	+2175
120				
121	+1350	+3375	+3600	+1875
122	+1950	+3675	+3450	+ 900
123	− 158	− 240	− 323	− 105
124	+ 600	+2100	+1950	+1350
125	+1050	+2850	+3000	+1850
126	+ 450	+2775	+2550	+2475
127	− 300	+3525	+3450	+ 675
128	− 263	− 270	− 315	− 53
129	− 368	− 338	− 450	− 150
130	− 68	− 180	− 225	+ 8
131	− 225	− 405	− 480	− 98
132	+ 525	+ 525	− 75	− 75

G.L.	1	2	3	4
133	− 180	− 338	− 113	− 15
134	− 225	− 308	− 68	0
135	− 210	− 263	− 45	− 15
136	− 210	− 263	− 128	+ 75
137	+ 900	+1800	+1950	+ 300
138	+ 450	+ 750	+ 150	+ 150
139	+ 375	+1350	+1100	+ 900
140	+1500	+2775	+2400	+ 75
141	+1125	+3600	+3000	+1575
142	+ 300	+1350	+ 675	+ 450
143	+ 150	+1050	+ 225	+ 300
144	+ 750	+1350	+ 825	− 375
145	+ 525	− 900	−3300	−2100
146	+ 173	+ 218	+ 218	0
147	+ 225	+ 248	+ 293	+ 233
148	+ 293	+ 645	+ 675	+ 323
149	+2475	+2475	+2400	− 150
150	+1500	+2550	+2325	+1500
151	+1950	+3375	+4050	+2775
152	+1875	+2325	+2925	+1500
153	+2625	+3300	+3525	+2700

G.L.	1	2	3	4
154	+1125	+1350	+1350	− 900
155				
156	+1425	+5475	+6825	
157	+1650	+5325	+4950	
158	+ 375	+1125	+2325	
159				
160	+ 750	+1650	+3600	+1350
161	+ 900	+1050	+1650	0
162				

— KEY —

= Loaded Area.

= Gage Line on Concrete

= Gage Line on Reinforcement.

Figure in ○ = Distance of ℄ of rod from surface of concrete.

6½" = Nominal thickness of slab.

6⅝-T = Actual thickness of slab.

2½-3½ = Depth of Drop head. (actual).

— TABLES —

(Live Load stresses only)

G.L. = Gage Line number.

1. = Stress, 4 panels loaded 142# sq. ft.

2. = Stress, 4 panels loaded 300# sq. ft.

3 = Stress, panels B & D only loaded 300# sq. ft.

4. = Load removed.

+ = Tension

− = Compression

Design Live Load = 150 lbs. per sq. ft.

E_s = 30,000,000 lbs. per sq. in.

E_c = 3,000,000 lbs. per sq. in.

Fig. 3—Plan of test portion of first floor showing location of extensometer measurements. The tables give the stresses according to the loadings indicated in the key.

w = Total live and dead load per sq. ft. = 142 + 82 = 224 lbs.

wl = Live load per sq. ft.

W = Total panel load in lbs. = wL^2.

Wl = Total live load on panel in lbs. = wlL^2.

W' = W — load within area of column capital.

d = Distance in inches from centre of gravity of centroid to centre of gravity of steel at the drop.

d_1 = Distance in inches from centre of gravity of centroid to centre of gravity of steel at the centre of slab. "Centroid" is used in the sense of equivalent compressive area.

s = Tensile stress per sq. inch in steel.

c = Extreme fibre compression stress per square inch in concrete.

—M = Moment at edge of capital head.

+M = Moment at centre of span.

Chicago Code

Extracts from Chicago Code, using the above notation:—

The negative bending moment taken at a cross-section of each strip A (Fig. 5) at the edge of a column capital or over it shall be taken as WL/30.

The positive bending moment taken at a cross-section of each strip A midway between column centres shall be taken as WL/60.

The positive bending moment taken at a cross-section of each strip B in the middle of the panel shall be taken as WL/120.

The negative bending moment taken at a cross-section of each strip B on the centre line of the columns shall be taken as —WL/120.

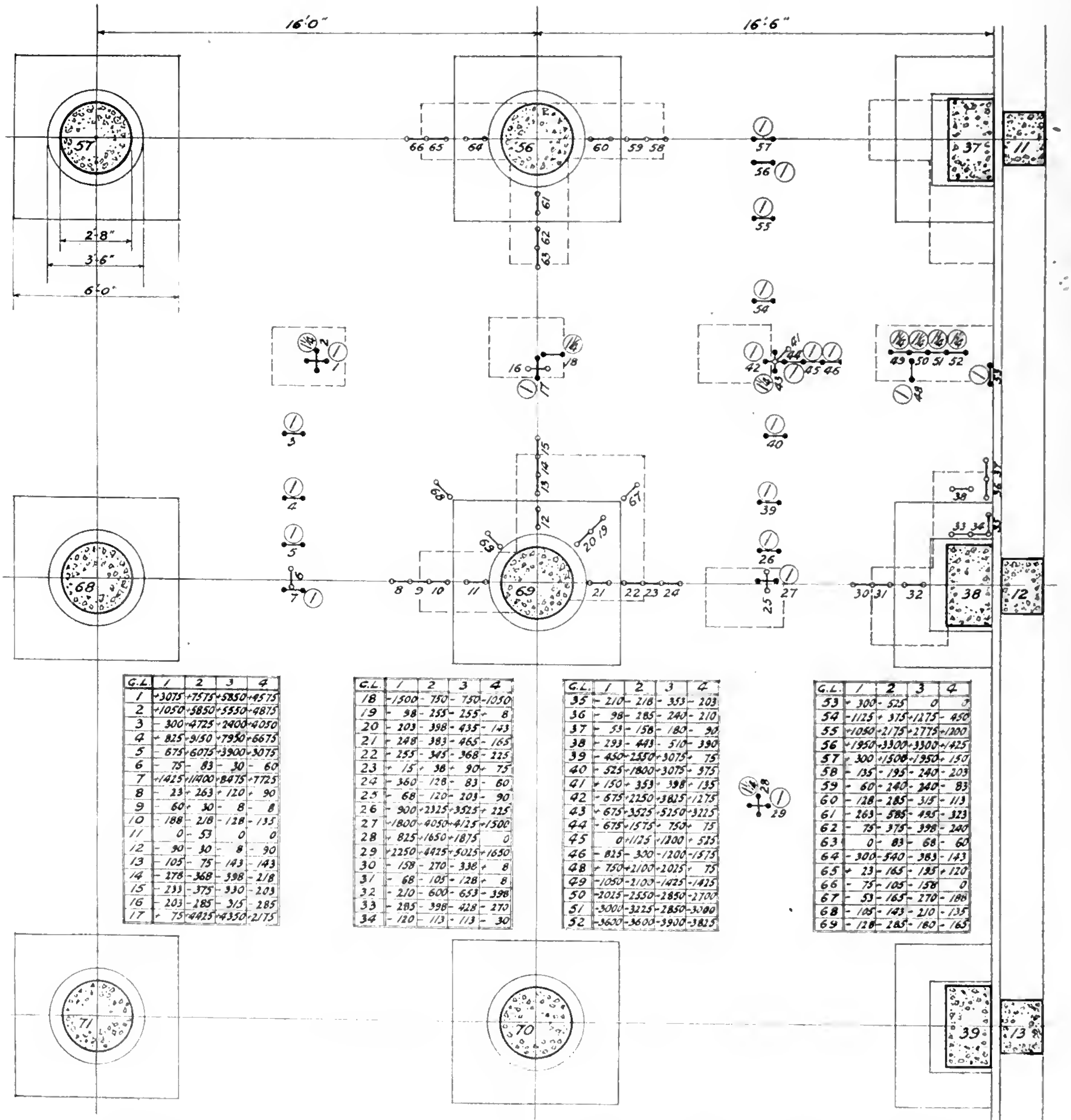
Referring to the plan of first floor, Fig. 3, it will be noted that L = 16 ft., and that the first load applied to the four panels was 142 lbs. per sq. ft.

The readings around column No. 69 for the stresses in strip A at the column capital will now be considered.

The plan of the first floor gives the readings for the stresses in the steel and the plan of the basement ceiling, Fig. 4, gives the corresponding stresses in the concrete.

[Note: The stresses given on the plans are for the live loads of 142 lbs. per sq. ft. and 300 lbs. per sq. ft.]

The stresses for the dead load would be approximately correct if taken in the direct proportion of the dead to the live load. Therefore, the stresses due to the dead load are 82/142, or about 4/7 of those due to the live load (if the elastic limit of the material is not passed. Most authorities give the elastic limit of concrete as very indefinite).



G.L.	1	2	3	4
1	+3075	+7575	+5850	+4575
2	+1050	+5850	+5550	+4875
3	-300	+4725	+2400	+4050
4	+825	+9150	+7950	+6675
5	-675	+6075	+3900	+3075
6	-75	-83	-30	-60
7	+1425	+11400	+8475	+7725
8	-23	+263	+120	+90
9	-60	+30	-8	-8
10	-188	-218	-128	-135
11	0	-53	0	0
12	-90	-30	-8	-90
13	-105	-75	-143	-143
14	-278	-368	-398	-218
15	-233	-375	-330	-203
16	-203	-285	-315	-285
17	+75	+4425	+4350	+2175

G.L.	1	2	3	4
18	-1500	-750	-750	-1050
19	-98	-255	-255	+8
20	-203	-398	-435	-143
21	-248	-383	-465	-165
22	-255	-345	-368	-225
23	+15	+38	+90	+75
24	-360	-128	-83	-60
25	-68	-120	-203	-90
26	-900	+2325	+3525	+225
27	+1800	+4050	+4125	+1500
28	+825	+1650	+1875	0
29	+2250	+4425	+5025	+1650
30	-158	-270	-338	+8
31	-68	-105	-128	+8
32	-210	-600	-653	-398
33	-285	-398	-428	-270
34	-120	-113	-113	-30

G.L.	1	2	3	4
35	-210	-218	-353	-203
36	-98	-285	-240	-210
37	-53	-158	-180	-90
38	-293	-443	-510	-390
39	-450	+2550	+3075	+75
40	+525	+1800	+3075	+375
41	+150	+353	+398	+135
42	-675	+2250	+3825	+1275
43	+675	+3525	+5250	+3225
44	-675	+1575	+750	+75
45	0	+1125	+1200	+525
46	-825	-300	-1200	-1575
48	+750	+2100	+2025	+75
49	-1050	-2100	-1425	-1425
50	-2025	-2550	-2850	-2700
51	-3000	-3225	-2850	-3000
52	-3600	-3600	-3900	-3825

G.L.	1	2	3	4
53	+300	+525	0	0
54	-1125	+375	+1275	-450
55	+1050	+2175	+2775	+1200
56	+1950	+3300	+3300	+1425
57	+300	+1500	+1950	+150
58	-135	-195	-240	-203
59	-60	-240	-240	-83
60	-128	-285	-315	-113
61	-263	-585	-495	-323
62	-75	-375	-398	-240
63	0	-83	-68	-60
64	-300	-540	-383	-143
65	+23	-165	-195	+120
66	-75	-105	-158	0
67	-53	-165	-270	-188
68	-105	-143	-210	-135
69	-128	-285	-160	-165

Fig. 4. Plan of test portion of basement ceiling, showing location of extensometer measurements. The tables give the stresses.

The following stresses are for a live load of 142 lbs. per sq. ft. (Refer to Figs. 3 and 4).

Reading No. 137 gives stress in steel = 900 lbs tension in top.
Reading No. 11 gives stress in concrete = 0 lbs. tension in bottom.

Reading No. 140 gives stress in steel = 1500 lbs. tension in top.
Reading No. 12 gives stress in concrete = 90 lbs. compression in bottom.

Reading No. 153 gives stress in steel = 2625 lbs. tension in top.
Reading No. 21 gives stress in concrete = 248 lbs. compression in bottom.

On referring to readings Nos. 137 and 11 it will be

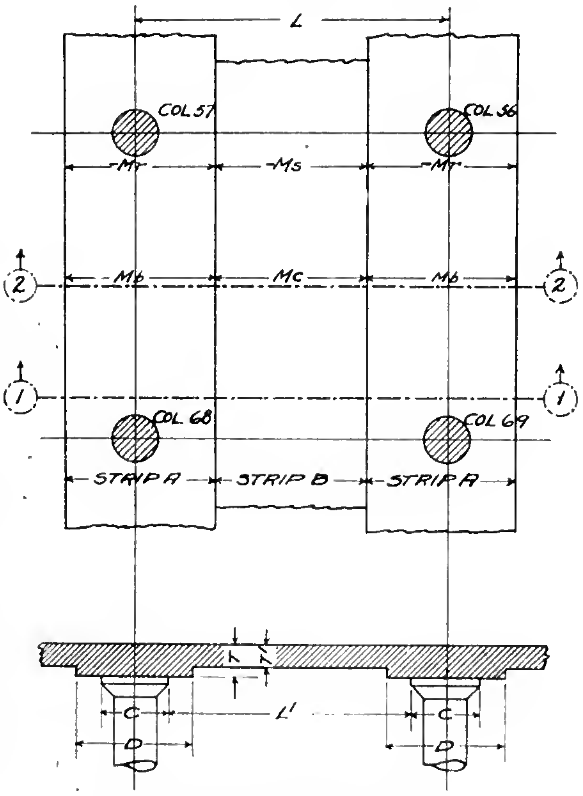


Fig. 5—General diagram of flat slab floor.

noticed that the stress in number 11 is zero, so we cannot consider a section though 137, and the readings for Nos. 153 and 21 are on the wall side, which we are not now considering. This, therefore, leaves the readings Nos. 140 and 12 as the ones to be considered.

Assume a section to be taken along 1 . . . 1, Fig. 5, cutting through the centre of 140 and 12 and running parallel to columns 68 and 69. Referring to this diagram it will be noticed that the negative bending moment in strip A, Mr = — WL/30, and since Wl = 142 × 16 × 16 = 36352 lbs., therefore, Mr = — (36352 × 16 × 12)/30 in.-lbs. = 232652 in-lbs.

Referring to Section 1-1, Fig. 6, it will be noticed that there are twenty ½-in. rods and that they are 2 in. below the concrete. From this section Fig. 8 has been made.

A = 4 sq. ins. = ½ per cent. of steel. The unit stress in the steel at No. 140 due to the live load according to the Chicago Code is—

s = 232652/(4 × 6.6) = 8812 lbs. per sq. in.

which is about 5.9 times as great as that given by the extensometer reading number 140, which was 1500 lbs.

If the compressive stress in the concrete is now considered, then c/2 × 2.7 × 6.6 × 96 = 232652;

Therefore c = 272 lbs. per sq. in., which is about three

By-Law	Strip A	Strip B	Mr	Mb	Ms	Mc	C	D	T	T'
Chicago	$\frac{L}{2}$	$\frac{L}{2}$	$-\frac{WL}{30}$	$\frac{WL}{60}$	$-\frac{WL}{120}$	$\frac{WL}{120}$	.225L			6" or $\frac{L}{32}$
Philadelphia	$\frac{45}{100}L$	$\frac{45}{100}L$	$-\frac{WL}{31}$	$\frac{WL}{77.5}$	$-\frac{WL}{124}$	$\frac{WL}{124}$	.2L	$\frac{38}{100}L$	$1\frac{2}{3}T'$	
Joint Comm	$\frac{L}{2}$	$\frac{L}{2}$	$-\frac{WL}{25}$	$\frac{WL}{55}$	$-\frac{WL}{100}$	$\frac{WL}{133}$	.2L			6" or $\frac{L}{32}$

Table 1—Chicago and Philadelphia codes and Joint Committee recommendations compared. T, T', C and D are minimum dimensions allowed by codes.

Reading No	12	140-1	16	132	134	136	1	2
Stress in	Conc	Steel	Conc.	Steel	Conc.	Conc	Steel	Steel
Chicago Code	-556	13860	-237	15900	-215.8	-215.8	15050	15050
Philadelphia	-537	13410	-258	16650	-235	-235	15880	15880
Pittsburg	-723	9750						
Joint Comm	-667	16600	-288.5	18930	-194.5	-194.5	13590	13590
Test	-142	2080	-316	824	-355	-331	4850	1656

Table 2—Comparison of stresses for live and dead loads combined according to various by-laws with those found by test. Stresses are in lbs. per square in.

Reading No	12	140-1	16	132	134	136	1	2
Stress in	Conc	Steel	Conc	Steel	Conc	Conc.	Steel	Steel
Chicago Code	-105	2100	144	448	-141	-141		940
Philadelphia	-101.5	1625	155	516	-151.5	-151.5		1010
Joint Comm.	-126	2520	173	576	-127	-127		848
Test	-142	2080	-316	825	-355	-331	4850	1656

Table 3—Comparison of stresses for live and dead loads combined according to various by-laws with those found by test using the section modulus determined by deformation readings.

times as great as that given by reading number 12, which was 90 lbs.

Referring to Fig. 5 again, the bending moment at the centre of strip A is Mb = WLL/60 = (36352 × 16 × 12)/60 = 116326 in.-lbs.

Referring to section 2-2, Figs. 5 and 7, it will be seen that there are fourteen ½-in. rods and that they are 1 inch from the bottom of the concrete. From this section Fig. 9 has been made.

Reading number 17, Fig. 4, gives steel stress = 75 lbs.

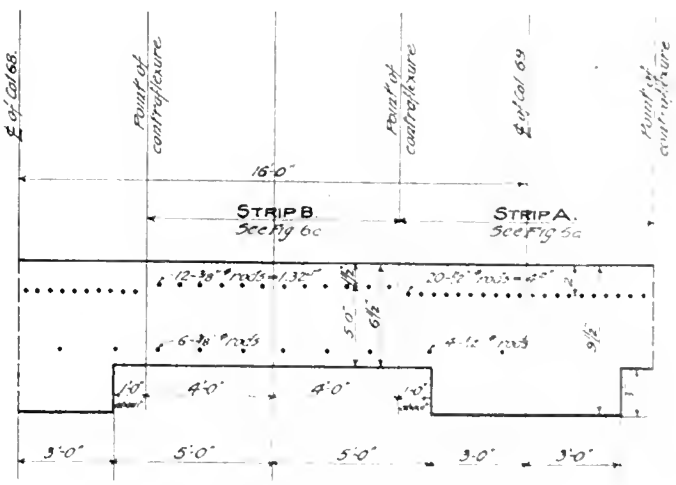


Fig. 6 -Section through 1-1 of Fig. 5.

per square inch tension. Reading number 7 gives steel stress 1425 lbs. per square inch tension.

Since Mb = 116326 in lbs. as found above, therefore, s = 116326 (2.75 × 4.84) = 8739 lbs. per sq. in., which is more than six times as great as reading No. 7, the greater of the two readings.

As there were no corresponding readings taken on the concrete it is impossible to compare them to the Chicago code.

Referring again to Fig. 5, the negative bonding moment will now be found for strip B.

Ms = — Wl.L/120 = (36352 × 16 × 12)/120 = 58163 in.-lbs.

Referring to section 1-1, Figs. 5 and 6, it will be noticed that there are twelve 3/8-in. rods (= 1.32 sq. in.) and that the rods are 1½ in. below the top of the concrete, and from this section Fig. 10 has been made.

s = 58163/(1.32 × 4.4) = 10030 lbs. per sq. in. tension in steel.

By referring to reading No. 132, Fig. 3, it will be found to be 525 lbs., hence the Chicago code gives a computed stress 20 times as great as that given by the reading.

c/2 × 1.8 × 96 × 4.4 = 58163

Therefore, c=153 lbs. per sq. in. compression in the concrete.

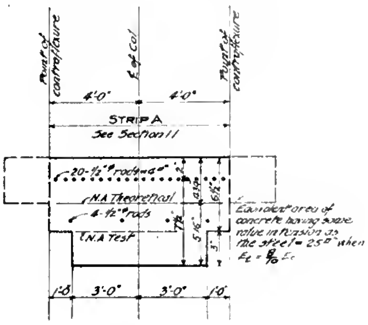


Fig. 6a.

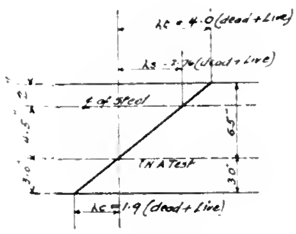


Fig. 6b.

Referring to reading No. 16, Fig. 4, it will be noticed that the stress given is 203 lbs. per sq. in., which is greater than that found by the Chicago code.

Referring to Fig. 5 again, the bending moment for the centre of strip B is Mc = Wl.L/120 = 58163 in.-lbs., the same as Ms.

Referring to section 2-2, Figs. 5 and 7, it will be found that there are twelve 3/8-in. rods (= 1.32 sq. ins.) and that the rods are 1¼ in. from the bottom of the concrete, and from this section Fig. 11 has been made.

s = 58163/(1.32 × 4.62) = 9535 lbs. per sq. in. tension in steel.

Referring to readings Nos. 1 and 2 it will be found that No. 1 gives a stress of 3075 lbs. per sq. in., and No. 2 a stress of 1050 lbs. per sq. in., hence the Chicago code gives a stress three times as great in the former and nine times as great in the latter as found by test.

Philadelphia Code

The second by-law considered will be the Philadelphia code. Extracts from the Philadelphia code, using the same notation as before, follow:

"The column capital shall have a diameter at the top

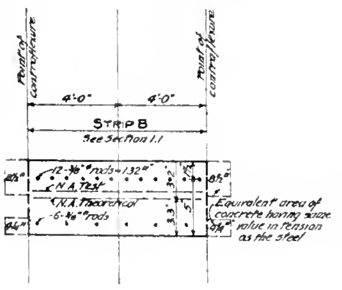


Fig. 6c.

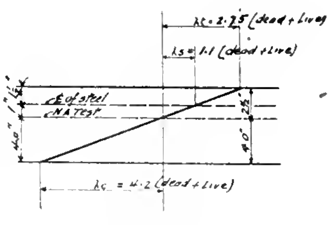


Fig. 6d.

in no case less than 0.2 L where L is the length of the longest side, centre to centre of columns for square capitals.

"The depressed head or drop may be cast above the column capital and the width of this drop shall be 0.38 L and the depth of the drop shall not be less than 2/3 the thickness of the slab.

"The width of bands shall be such as to properly cover the panel area, but shall not be wider than 0.45 L.

"Load carried by straight band = (Total bay — capital head)/2 × w.

— M = (Total bay — capital head)/2 × wL_1/12 ... ... (1)

+ M = (Total bay — capital head)/2 × wL_1/24 ... ... (2)

"Width of concrete to resist compression at edge of capital head = width of drop.

"Width of concrete to resist compression in centre of the span = width of band = 0.45 L."

Taking 0.2 L as the diameter of capital head and substituting this value in equations (1) and (2) we obtain:—

— M = WL/31 ft. lbs. ... ... (3)

+ M = WL/62 ft. lbs. ... ... (4)

Areas of steel required to resist these moments are:—

A = — M/16000 d

and A_1 = + M/16000 d_1

The areas of steel thus determined are, according to the Philadelphia code, to be distributed in the slab as follows:—

"Place 100% of A over capital head to resist — M.

" 80% of A_1 in centre of straight bands to resist + M.

" 50% of A_1 in centre between straight bands to resist + M_1.

" 50% of A_1 in centre of straight bands to resist — M_1."

The moments to be provided for in strips A and B in accordance with the above distribution of steel are shown

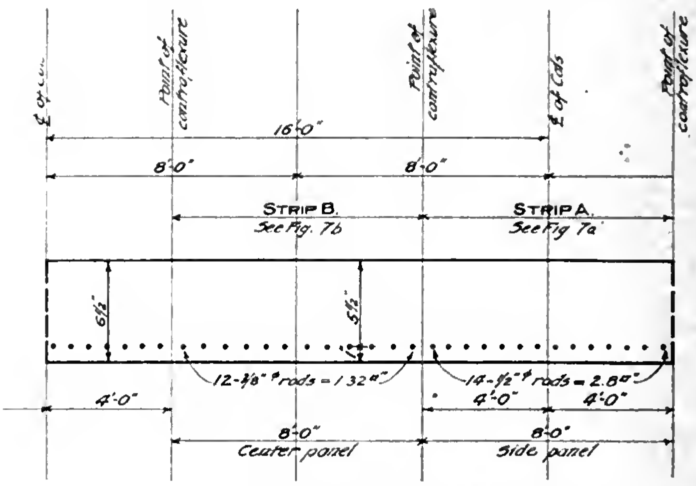


Fig. 7—Section through 2-2 of Fig. 5.

in Table 1. Thus, over capital head, moment = 100% of — M = — WL/31 ft. lbs.

At middle of strip A, moment = 80% of + M = .8 × WL/62 ft. lbs. = WL/77.5 ft. lbs.

At middle of strip B, moment = 50% of + M = .5 × WL/62 = WL/124 ft. lbs.

In strip B at centre line of column moment is the same as at middle, but opposite in sign = — WL/124 ft. lbs.

These moments are nearly the same as those called for by the Chicago By-law so that the computed stresses would be about the same as found before.

Pittsburg By-Law

The third by-law considered will be that of Pittsburg, extracts of which are as follows:

Stresses.—All unit stresses shall be as specified in the ordinance governing the use of concrete and reinforced concrete. The resisting moment and coincident stresses shall be computed under the assumption set forth in the ordinance.

Moments.—The negative bending moment at the support shall be taken $W'L_1$/11 in which W' equals the total load on one panel exclusive of any load within the area of the column capital, and L_1 is the clear span between column capitals measured along the side of the panel.

The positive moment at the centre of the panel shall be taken as WL/16 in which W is the total load on a panel

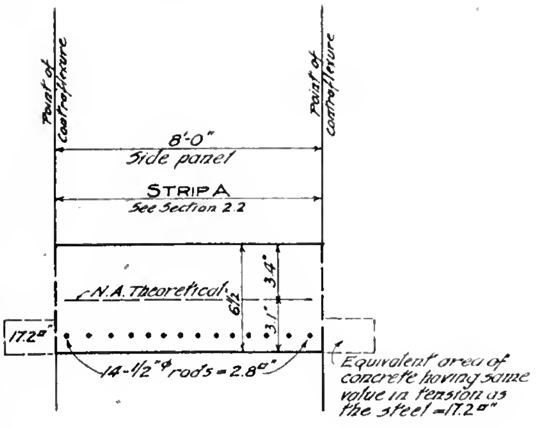


Fig. 7a.

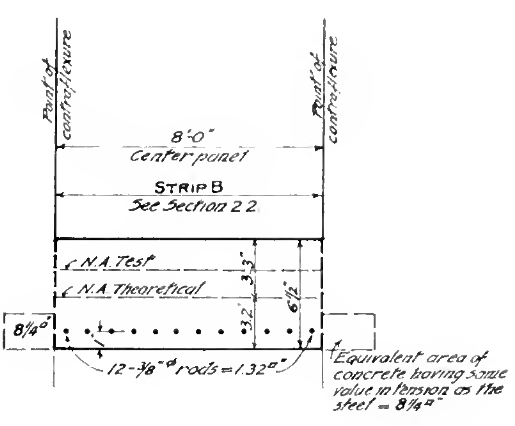


Fig. 7b.

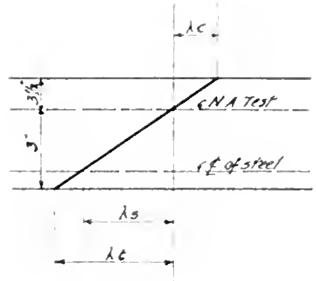


Fig. 7c.

and L the distance centre to centre of columns measured along the side of the panel.

Resisting Sections.—The negative moment at the support shall be considered as acting on a vertical section passing through the slab along the periphery of the column capital. The compressive stress in the concrete on this section shall be calculated by the ordinary straight line assumptions of stress distributed, by the formulae given in the ordinance, taking the periphery of the column capital, as the width of the section and the depth from the lower face of the concrete adjoining the column capital to the centre of gravity of the slab steel as the depth of the section.

The area of slab steel resisting the negative moment of $W'L_1/11$ at the support shall be taken as the total section of all slab rods cutting a conical critical section starting at the periphery of the column capital and flaring outwards at a 45 degree angle with the vertical. The spacing of rods thus determined for the width of the critical section shall be maintained for the full width of the bands.

The positive moment at the centre shall be resisted by the steel and concrete cut by a vertical critical section through the slab having its centre at the column centre and its diameter equal to the main dimension of the sides of the panel.

Drop Construction.—The thickness of the slab adjacent to the column capital may be increased, if necessary, by means of a depending concrete drop panel centered on the column centre. Where this drop panel is used the resisting moment of the slab at the periphery of the drop shall be not less than that calculated from the formula $W' \times L_1/11 \times X^2/2L_1 \times X/2$ in which W' and L_1 are as defined above and X is the distance between the edge of the column capital and circle of area equal to that of the drop used. This drop panel may be diminished in thickness at greater distance from the column capital if desired, provided the resisting moment at any section shall not fall below the value determined by the above formula applied to that particular section.

Referring to this by-law it will be noted that the bending moment at the column capital is considered to act in a radial direction. The resisting concrete is assumed to be that cut by a vertical plane through the circumference of the column capital. If the diameter of the capital is taken as 0.2 L in accordance with the Philadelphia by-law, the circumference becomes equal to 5L/8 and therefore the width of the resisting concrete for one band is 5L/32 (for the two-way system).

By referring to Fig. 12 it will be noted that only three-quarters of a band of steel may be considered as resisting the negative moment. The total negative bending moment at the support is given in this by-law as $W'L_1/11$. Assuming diameter of capital $= 0.2$ L as before, then $L_1 = 0.8$ L and $W' = 0.97$ W, and total negative bending moment at support $= .8 \times .97 \times W'L_1/11 = 776$ WL/11000 ft. lbs. $=$ WL/14.2 ft. lbs. (approximately)

This is resisted by 4 partial bands of steel, therefore, —Mr $=$ WL/57 and is resisted by three-quarters of a band of steel, and one-quarter of the circumference of the column cap by the thickness of the concrete.

Referring again to the test — Mr $= (36352 \times 16 \times 12)/$-57 in. lbs. $= 122450$ in. lbs. This is resisted by three-quarters of 4 sq. in. $= 3$ sq. ins.,
Therefore, $s = 122450/(3 \times 6.6) = 6184$ lbs. per sq. in.

This is about four times that given by reading No. 140 in the test, which was 1500 lbs.

Now one-quarter of the circumference of the column cap is $\frac{1}{4} \times 2 \times 22/7 \times 0.1$ L $=$ 5L/32.
Therefore, for the compression stress in the concrete, we have (see Fig. 8):—$c/2 \times 2.7 \times 5/32 \times 16 \times 12 \times 6.6 =$ 122450 in-lbs. Therefore, $c = 458$ lbs. per sq. in., which is about five times the stress given by reading No. 12, which is 90 lbs.

On taking the actual size of the capital for the case under consideration (3 ft. 6 in. diam.), the bending moment for ¼ of

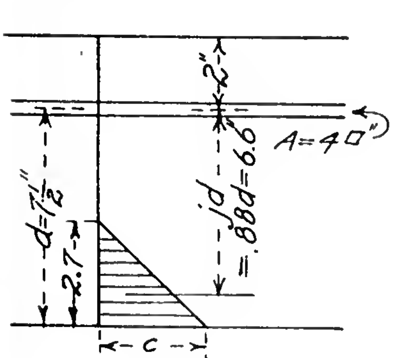


Fig. 8.

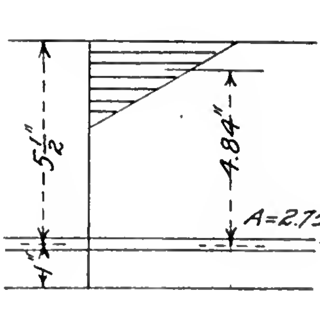


Fig. 9.

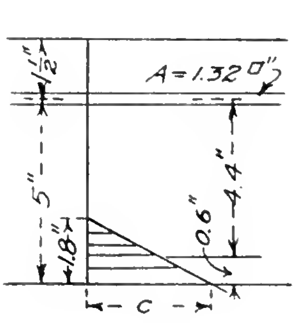


Fig. 10.

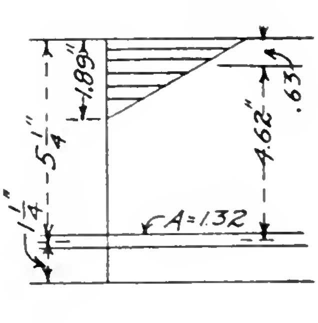


Fig. 11.

circumference of cap is $\frac{1}{4} \times W'L_1/11 = \frac{1}{4} \times (36352 - 1367)\ 12\frac{1}{2} \times 12/11 = 119268$ in.-lbs.

$c/2 \times 2.7 \times 22/7 \times 42 \times \frac{1}{4} \times 6.6 = 119268.$

Therefore c = 406 lbs. per sq. in., which is about 4½ times that given by reading No. 12.

The total positive moment at the centre of the panel is given as WL/16 and is resisted by all steel and concrete cut by a vertical plane through the circumference of a circle whose diameter is equal to L and whose centre is at the centre of the column.

EXTENSOMETER READINGS OF DEFORMATIONS CAUSED BY LIVE LOADS.

Ceiling

GAGE LINE	142# ON 4 PANELS	300# ON 4 PANELS	300# ON 2 PANELS	LOAD REMOVED	GAGE LINE	142# ON 4 PANELS	300# ON 4 PANELS	300# ON 2 PANELS	LOAD REMOVED
1	+4.1	+10.1	+7.8	+6.1	35	-2.8	-2.9	-4.7	-2.7
2	+1.4	+7.8	+7.4	+6.5	36	-1.3	-3.8	-3.2	-2.8
3	-0.4	+6.3	+3.2	+5.4	37	-0.7	-2.1	-2.4	-1.2
4	+1.1	+12.2	+10.6	+8.9	38	-3.9	-5.9	-6.8	-5.2
5	-0.9	+8.1	+5.2	+4.1	39	-0.6	+3.4	+4.1	+0.1
6	-1.0	-1.1	-0.4	-0.8	40	-0.7	+2.4	+4.1	+1.3
7	+1.9	+15.2	+11.3	+10.3	41	+2.0	+4.7	+5.3	+1.8
8	-0.3	+3.5	+1.6	+1.2	42	-0.9	+3.0	+5.1	+1.7
9	-0.8	+0.4	-0.1	-0.1	43	+0.9	+4.7	+7.0	+4.3
10	-2.5	-2.9	-1.7	-1.8	44	-0.9	+1.1	+1.0	+0.1
11	0.0	-0.7	0.0	0.0	45	0.0	+1.5	+1.6	+0.7
12	-1.2	-0.4	-0.1	-1.2	46	-1.1	-0.4	-1.6	-2.1
13	-1.4	-1.0	-1.9	-1.9	48	+1.0	+2.8	+2.7	+0.1
14	-3.7	-4.9	-5.3	-2.9	49	-1.4	-2.8	-1.9	-1.9
15	-3.1	-5.0	-4.4	-2.7	50	-2.7	-3.4	-3.8	-3.6
16	-2.7	-3.8	-4.2	-3.8	51	-4.0	-4.3	-3.8	-4.0
17	+0.1	+5.9	+5.8	+2.9	52	-4.8	-4.8	-5.2	-5.1
18	-2.0	-1.0	-1.0	-1.4	53	+0.4	-0.7	0.0	0.0
19	-1.3	-3.4	-3.4	+0.1	54	-1.5	+0.5	+1.7	-0.6
20	-2.7	-5.3	-5.8	-1.9	55	+1.4	+2.9	+3.7	+1.6
21	-3.3	-5.1	-6.2	-2.2	56	+2.6	+4.4	+4.4	+1.9
22	-3.4	-4.6	-4.9	-3.0	57	+0.4	+2.0	+2.6	+0.2
23	+0.2	+1.3	+1.2	+1.0	58	-1.8	-2.6	-3.2	-2.7
24	-4.8	-1.7	-1.1	-0.8	59	-0.8	-3.2	-3.2	-1.1
25	-0.9	-1.6	-2.7	-1.2	60	-1.7	-3.8	-4.2	-1.5
26	-1.2	+3.1	+4.7	+0.3	61	-3.5	-7.8	-6.6	-4.3
27	+2.4	+5.4	+5.5	+2.0	62	-1.0	-5.0	-5.3	-3.2
28	+1.1	+2.2	+2.5	0.0	63	0.0	-1.1	-0.9	-0.8
29	+3.0	+5.9	+6.7	+2.2	64	-4.0	-7.2	-5.1	-1.9
30	-2.1	-3.6	-4.5	+0.1	65	+0.3	-2.2	-2.6	+1.6
31	-0.9	-1.4	-1.7	+0.1	66	-1.0	-1.4	-2.1	0.0
32	-2.8	-8.0	-8.7	-5.3	67	-0.7	-2.2	-3.6	-2.5
33	-3.8	-5.3	-5.7	-3.6	68	-1.4	-1.9	-2.8	-1.8
34	-1.6	-1.5	-1.5	-0.4	69	-1.7	-3.8	-2.4	-2.2

+ = Tension — = Compression

Note. Deformation readings are multiplied 5,000 times.

Table 4. Deformations are measured per 8 in. Therefore, to obtain actual deformation per unit length, divide by 8 x 5,000.

For the positive moment resisted by one straight band A and one centre band B, (which would be a summation of Mb and Mc for the Chicago and Philadelphia By-laws) the bending moment will be WL/64.

Then $WL/64 = 36352 \times 16 \times 12/64 = 109056$ in.-lbs. and $s = 109056/(2.75 + 1.32)\ 4.62 = 5801$ lbs. per sq. in. (See Fig. 11), which is more than four times what is given by test (see reading No. 7).

Joint Committee Report

The report of the Joint Committee on Concrete and Reinforced Concrete will now be considered.

The negative moment for the width of an interior square panel is taken as: $-(wL/15)\ (L - 2/3\ C)^2$ where C is the diameter of the column capital.

If C = 0.2 L this becomes $-169\ wL^3/3375 = -wL^3/20$ (approximately) = — WL/20 (approximately).

Twenty per cent. of this moment, i.e.—WL/100, is to be provided for in the mid-section. This corresponds to the negative moment in strip B of the Chicago By-law.

For slabs having drop panels, 80 per cent. of the moment, or — WL/25, is to be provided for in the two column head sections of the panel; i.e., the negative moment in strip A of the Chicago by-law would be — WL/25 by the Joint Committee Report.

For slabs without drop panels, 65 per cent. of — WL/20 = — WL/31, approximately, is taken as the negative moment in strip A.

The positive moment for the width of an interior square panel is taken as $(wL/25)\ (L - 2/3\ C)^2$ which becomes WL/33, approximately, when C = 0.2 L.

25 per cent. of this moment = WL/133, is to be provided for in the inner section corresponding to strip B of the Chicago by-law.

For slabs having dropped panels 60 per cent. of the moment WL/33, or WL/55, is to be provided for in the two outer sections, which together correspond to strip A of the Chicago by-law, and the thickness of slab away from the dropped panel is to be determined by using 70 per cent. of WL/33 = WL/47, approximately.

For slabs without dropped panels 55 per cent. of WL/33, or WL/60, is to be provided for in strip A.

The negative moment in strip A would then be—

$(36352 \times 16 \times 12)/25 = 279000$ in.-lbs.

Referring to Fig. 8 the computed stress in the steel is $279000/(4 \times 6.6) = 10570$ lbs. per sq. in., which is about 7 times as great as that given by reading No. 140.

The computed compression stress in the concrete will be 326 lbs. per sq. in., which is about 3.6 times as great as that given by reading No. 12.

The positive moment in strip A would be WLL/55 = $(36352 \times 16 \times 12)/55 = 126900$ in.-lbs., and the computed stress in the steel = $126900/(2.75 \times 4.84) = 9520$ lbs. per sq. in. (see Fig. 9), which is 6.7 times that given by reading No. 7.

EXTENSOMETER READINGS OF DEFORMATIONS CAUSED BY LIVE LOADS.

Floor.

GAGE LINE	142# ON 4 PANELS	300# ON 4 PANELS	300# ON 2 PANELS	LOAD REMOVED	GAGE LINE	142# ON 4 PANELS	300# ON 4 PANELS	300# ON 2 PANELS	LOAD REMOVED
101	+1.9	+1.5	+2.0		133	-2.4	-4.5	-1.5	-0.2
102	+3.4	+3.9	+3.6	+1.8	134	-3.0	-4.1	-0.9	0.0
103	+2.7	+5.0	+7.6	+5.9	135	-2.8	-3.5	-0.6	-0.2
104	+2.2	+2.9			136	-2.8	-3.5	-1.7	+1.0
105	+2.1	+3.1	+2.9		137	+1.2	+2.4	+2.6	+0.4
106	+1.3	+4.0	+2.9		138	+0.6	+1.0	+0.2	+0.2
107	+1.6	+4.4	+2.3		139	+0.5	+1.8	+1.6	+1.2
108	+0.2	+1.4	+1.1		140	+2.0	+3.7	+3.2	+0.1
109	0.0	+1.8	+0.1		141	+1.5	+4.8	+4.0	+2.1
111	+5.3	+6.5	+2.4		142	+0.4	+1.8	+0.9	+0.6
112	+1.6	+3.9	+2.8		143	+0.2	+1.4	+0.3	+0.4
113	+1.8	+0.9	+3.8	+1.2	144	+1.0	+1.8	+1.1	-0.5
114	+3.5	+5.7	+4.9	-0.2	145	+0.7	-1.2	-4.4	-2.8
118	+0.4	+2.7	+4.6	+2.2	146	+2.3	+2.9	+2.9	0.0
119	+0.2	+3.8	+3.1	+2.9	147	+3.0	+3.3	+3.9	+3.1
121	+1.8	+4.5	+4.8	+2.5	148	+3.9	+8.6	+9.0	+4.3
122	+2.6	+4.9	+4.6	+1.2	149	+3.3	+3.3	+3.2	-0.2
123	-2.1	-3.2	-4.3	-1.4	150	+2.0	+3.4	+3.1	+2.0
124	+0.8	+2.8	+2.6	+1.8	151	+2.6	+4.5	+5.4	+3.7
125	+1.4	+3.8	+4.0	+3.8	152	+2.5	+3.1	+3.9	+2.0
126	+0.6	+3.7	+3.4	+3.3	153	+3.5	+4.4	+4.7	+3.6
127	-0.4	+4.7	+4.6	+0.9	154	+1.5	+1.8	+1.8	-1.2
128	-3.5	-3.6	-4.2	-0.7	156	+1.9	+7.3	+9.1	
129	-4.9	-4.5	-6.0	-2.0	157	+2.2	+7.1	+6.6	
130	-0.9	-2.4	-3.4	+0.1	158	+0.5	+1.5	+3.1	
131	-3.0	-5.4	-6.4	-1.3	160	+1.0	+2.2	+4.8	+1.8
132	+0.7	+0.7	-0.1	-0.1	161	+1.2	+1.4	+2.2	0.0

+ = Tension. — = Compression.

Note. Deformation readings are multiplied 5000 times.

Table 5.—Deformations are measured per 8 in. To obtain actual deformation per unit length divide by 8 x 5,000.

The negative moment in strip B = — WLL/100 = $(36352 \times 16 \times 12)/100 = 69700$ in.-lbs.

and $s = 69700/(1.32 \times 4.4) = 12000$ lbs. per sq. in. (see Fig. 10), or about 23 times that given by reading No. 132.

$c = (69700 \times 2)/(1.8 \times 96 \times 1.4) = 183$ lbs. per sq. in. (see Fig. 10).

Reading No. 16 gives 203 lbs. per sq. in. as the stress in the concrete. The positive moment in strip B is WLL/133 = 52500 in.-lbs., and $s = 52500/(1.32 \times 4.62) = 8600$ lbs. per sq. in. (see Fig. 11), which is 2.8 times that given by reading 1 and more than 8 times as great as reading 2.

Discussion of the By-Laws

From a comparison of the different by-laws with the tests it would appear as if none of the codes were drafted on a proper basis. This is due to the fact that no code takes into consideration the tension in the concrete. All authorities without exception approve of this ruling. Taylor and Thompson, on page 414 of their Treatise on "Concrete, Plain and Reinforced," state that "tensile resistance of concrete cannot be counted upon, as it is often destroyed either by shrinkage due to hardening or by temperature changes." Construction joints also make it uncertain. This is clearly demonstrated by one test the Department has made. When considering the stresses in the steel measured by actual test

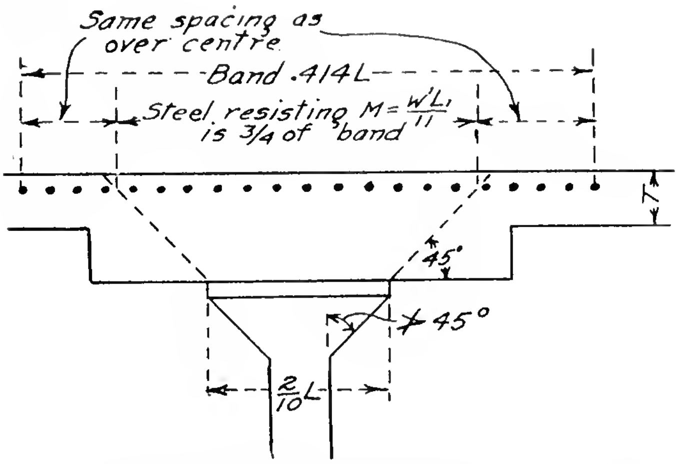


Fig. 12—Pittsburg code considers only three-quarters of band of steel as resisting negative moment.

it is necessary to take the tension in the concrete into consideration. It is evident that when a piece of steel embedded in concrete is subjected to tension the concrete must elongate the same amount as the steel up to the point of cracking of the concrete.

J. B. Johnson, in "Materials of Construction," 1914 edition, page 72b, states that concrete of 1:2:4 mix will take tension until the steel is stressed up to a stress of from 2000 to 5000 lbs. per sq. in. Taylor and Thompson give 3600 lbs. per sq. in. in the steel (1916 edition, p. 407). Geo. H. Hool, in "Reinforced Concrete Construction," Vol. 1, p. 52, verifies this also.

On examining the tests it will be noted that, for the 142 lbs. live load, in no case has the steel been stressed up to these figures, including the stress due to the dead load, which as mentioned before is about 4/7 as great as that given for the live load stresses. On account of this fact, this discussion has been confined to the tests for the 142 lbs. per sq. ft. live load, so that the actual resisting moment could be arrived at due to there being no cracks in the concrete. Thus, if the moment of inertia and section moduli of the section are found after substituting for the steel the equivalent area of concrete, then the extreme fibre stresses of the concrete in tension and compression may be computed. (See "Materials of Construction," by Johnson, p. 72).

Following up the idea given above, the neutral axes of strips A and B have been computed for their theoretical and actual positions at the time the readings were taken. It will be noted that in no case does the theoretical position agree with the actual position of the neutral axis. (This point is carefully discussed in Taylor and Thompson, page 411, and it will not be touched on here). The actual position of the neutral axis according to test has been taken in computing the moments of inertia of the sections.

For the floor slab in question:—

Es = modulus of elasticity of steel = 30,000,000.

Ec = modulus of elasticity of concrete in compression = 3,000,000 to 3,500,000.

Et = modulus of elasticity of concrete in tension = 2,400,000 2,800,000, on the assumption that Et = .8 Ec, which is given by most authorities.

c = compressive strength of concrete per sq. in. = 3900 lbs. by test of material used at the job.

ct = tensile strength of concrete per sq. in.

"Materials of Construction," by J. B. Johnson, gives ct =c/12, and "Masonry Construction," by Ira O. Baker, gives ct from c/6 to c/12, when the compressive strength is determined by crushing cubes. This ratio seems to be independent of the proportion or the age. (See page 204, bottom paragraph, 1913 edition. Also see page 202, table 36, which gives the tensile strength of concrete of 1:2:4 mix as 228 lbs. per sq. in., average of five tests).

If c is 3900 then ct = c/12 = 325 lbs., which seems rather high.

A = area of steel per unit width.

Qc = section modulus, compression side.

Qt = section modulus, tension side.

λc = deformation of concrete in compression × 5000.

λt = deformation of concrete in tension × 5000

λs = deformation of steel × 5000.

Minus sign indicates compression. Plus sign indicates tension.

[Note.—The readings given in tables Nos. 4 and 5 are 5000 times as large as actual deformation, as the extensometer used multiplied the deformations by 5000.]

Referring to section 1-1, Fig. 6, and assuming the section to be divided into strips similar to those of the Chicago code, the moment of inertia of the section shown in Fig. 6a may be found, using the actual neutral axis as plotted from deformations.

I = 10457 (using actual N.A. found by test).

Qc = 3485 (using actual N.A. found by test).

Qt = 1608 (using actual N.A. found by test).

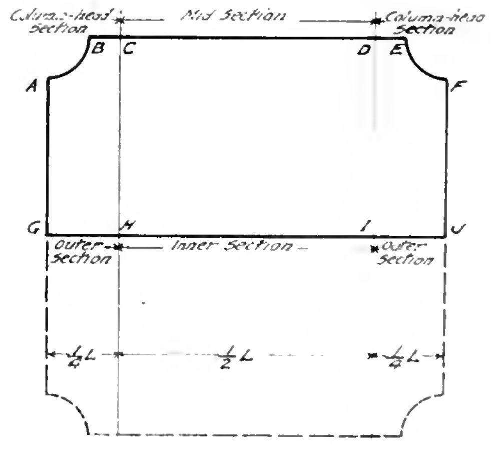


Fig. 13—Panel arrangement according to joint committee theory.

Referring to Fig. 6b it will be seen that λc = 1.9 and λt = 4.0. These have been found from reading No. 12 and the average of readings Nos. 140 and 141 (Tables 4 and 5) by assuming that the deformation due to the dead load is proportional to the deformation due to the live load.

Then using the Chicago code:

Mr = — WL/30 = 364800 in.-lbs.

Therefore, Mr/Qc = 364800/3485 = 105 lbs. per sq. in compression in extreme fibre of concrete, and

Mr/Qt = 364800/1608 = 228 lbs. per sq. in. tension in extreme fibre of concrete.

Referring again to Fig. 6b it will be noticed that λc =

1.9, therefore c = (1.9 × 3,000,000)/40,000 = 142 lbs. per sq. in. compression in extreme fibre of concrete, which is 37 lbs. more than that obtained by using the section modulus, which gives 105 lbs. per sq. in.

Using the deformation $\lambda t = 4$ we have ct = (4 × 2,400,000)/40,000 = 240 lbs. per sq. in. tension in extreme fibre of concrete.

It will be noticed that by using the section modulus a stress of 228 lbs. was obtained.

The stress in the steel may now be found as follows: c't = tension in concrete at steel level = 228 × 4.5/6.5 = 158 lbs. per sq. in.

Then s = tension in steel = (158 × 30,000,000)/2,400,000 = 1980 lbs. per sq. in.

Comparing this stress with that computed from actual deformation we get s = (2.76 × 30,000,000)/40,000 = 2080 lbs. per sq. in. in tension in steel according to test or just 100 lbs. per sq. in. greater than that obtained by using section modulus.

Referring to Fig. 6d it will be noticed that $\lambda t = 2.75$, therefore, ct = (2.75 × 2,400,000)/40,000 = 165 lbs. per sq. in. tension.

The deformation for the compression side was 4.2, therefore, c = (4.2 × 3,000,000)/40,000 = 316 lbs. per sq. in. compression.

Using the actual position of the neutral axis (see Fig. 6c) the moment of inertia was found to be 2567, Qt = 1026 and Qc = 642.

Using the Chicago Code, then

Ms = WL/120 = 91750 in.-lbs.

Then Ms/Qt = 91750/1026 = 89½ lbs. per sq. in. in tension.

and Ms/Qc = 91750/642 = 143 lbs. per sq. in. in compression.

By comparing the stresses arrived at by the deformation with those found by using the section modulus and the bending moment according to the Chicago By-law it will be noticed that the actual stresses are about double those found by the latter method.

The stress in the concrete at the steel level using the section modulus is as follows:—c't = 1/2.5 × 89½ = 36 lbs.

Therefore, stress in steel = (36 × 30,000,000)/2,400,000 = 448 lbs. per sq. in.

The stress in the steel using deformation is:—

s = (1.1 × 30,000,000)/40,000 = 825 lbs. per sq. inch, or nearly double that found by the Chicago Code.

We know that M = Qs where Q is the section modulus of any section and s is the stress per sq. inch in extreme fibre.

Therefore, Mt = 1026 × 165 = 169290

and Mc = 642 × 316 = 202872

Therefore, the average M = 186081.

Therefore, WL/x = 186081.

Therefore, x = WL/186081 = (57000 × 16 × 12)/186081 = 58.8.

Say x = 60

Then Ms = WL/60

But Mr = WL/30

Therefore, Ms + Mr = WL/20

which is almost the same as if the negative bending moment were taken considering the beam to be of uniform strength and fixed horizontally at both ends and loaded uniformly for its entire length.

If — M = bending moment for the full cross-section as shown by section 1-1, Fig. 6; and + M = bending moment for the full cross-section as shown by section 2-2, Fig. 7.

Then — M = 3WL/64 = WL/21.3 (Test gives WL/20 about) and + M = WL/64.

For a beam of equal and uniform section fixed horizontally at both ends and loaded uniformly its entire length which is the assumption on which the Chicago Code is based, — M = WL/24, and + M = WL/48.

Since there is a considerable difference between the readings Nos. 1 and 2, taken at the centre of the slab, and as there is no reading on the concrete to correspond to reading No. 17 at section 2-2, it is hardly practicable to compare the actual to the theoretical stresses across section 2-2.

It would seem from the meagre data before us that — M = 3WL/64 for full section,

and + M = WL/64 would give safer results than the Chicago Code or any of the others considered.

Paving Brick Manufacturers to Hold Conference Next Month

THE following communication has been received from the secretary of the National Paving Brick Manufacturers' Association:

Out of war conditions, the breakdown of railroad and express companies to move crops and supplies, and the extraordinary demand for better roads, the paving brick industry has been confronted with problems whose solution lies in study and conference on the part of all manufacturers. The annual meeting of the National Paving Brick Manufacturers' Association will be the occasion of such a conference, to which are invited all manufacturers of paving brick. As evidencing the spirit of the meeting the office board of the association says:

"The complex situation arising from the country's requirement for the greatest transportation facilities—with that very need hindering the receipt of materials and fuel needed in the manufacture of brick, as well as delaying paving work which should furnish transportation relief—with the Council of National Defence recommending short-haul freight to be transported over the highways—which are not—presents problems seldom found in business experience."

The Office Board of the National Paving Brick Manufacturers' Association is convinced that more good to the country and to the industry can be effected by a conference in which the entire industry is represented by its active executive officials than by any other undertaking.

We have concluded, therefore, to call a general conference of the paving brick industry, to be held in Cleveland, Ohio, November 19 and 20, 1917. All members of firms, board members of companies, and other persons having financial interests in the business are invited and urged to attend this important meeting. The program for the meeting is under preparation, and this, together with detailed information regarding the meeting, will be sent all manufacturers of paving brick as soon as prepared.

We are advised that the Dominion Government is negotiating with a New York financier for a contract to complete the Courtney Bay Harbor, at St. John, N.B. The Courtney Bay contract was originally let to the Norton, Griffiths Company, of Canada, but great difficulties occurred, with the result that the contract was cancelled.

It is reported that houses are being built in France from concrete made of ground slag mixed with hydraulic lime in the proportion of three sacks of lime to one cubic yard of slag. It is rammed between wooden frames to form walls about 18 inches thick, and is used for every kind of building, including cottages, country houses, warehouses, factories, etc.

Development of Mechanical Filter Bottoms and Strainer Systems

THE development of mechanical filter bottoms and strainer systems was discussed in a paper presented at the recent convention of the New England Waterworks Association by R. S. Weston, consulting engineer, Boston, Mass. The following article is abstracted from this paper:

The simplest and perhaps the earliest form of strainer system was a perforated metal plate. This is used no longer except for small filters. The next step in advance was to screw strainers or "sand valves" directly into the perforated metal plate. There have been many kinds of strainers. The early ones were made of fine, perforated metal or wire cloth, supported by a suitable brass casting. Later strainers were provided with drilled or punched holes or sawn slots. Most of the openings in these earlier strainers had a diameter or width of less than 0.1 mm.

Fine Perforations Clogged

In the earlier filters the sand rested directly upon the strainers, with the result that the fine perforations clogged quickly, making extensive and frequent repairs necessary. The remedy was to enlarge the perforations in the strainer and to place above the same a layer of graded gravel about 6 in. in thickness. This prevented the sand from reaching the strainer, and clogging did not occur. About the same time it was found that in the space below the false bottom the velocities of flow were so low that sand and coagulated matter accumulated, thereby furnishing a pabulum for the growth of bacteria. Therefore, notwithstanding the fact that the false bottom type of filter was ideal for the distribution of wash water, a pipe manifold was substituted for the false bottom, in order to maintain higher velocities in the underdrains.

The early filters were circular and were equipped with revolving rakes to agitate the sand during washing. Wash water velocities of less than one vertical foot per minute were used. Later (about 1893) the air agitation system was introduced by the Continental Filter Company, thus permitting rectangular construction and concrete filters. The rakes were abandoned soon after.

Tube Formed a Trap

The Little Falls plant, put in operation in 1903, typifies the best practice of the time. The strainer consisted of a perforated metal cap attached to a threaded fitting, from which a small tube depended. In one side of this tube, near the fitting, was a small hole, through which air passed for the purpose of agitating the sand layer. The dependent tube formed a trap so that the strainer could be used for both air and wash water distribution. This strainer system has been fairly successful, although it may fail to prevent hard spots in the filter from time to time, and especial cleanings of the filtering material may have to be made. Low wash water velocities were employed and air agitation was necessary.

The next large filter plant to be built was the one at Cincinnati, which was put in operation in 1907. This marked a new departure, in that air agitation was done away with and a wash water velocity of 22 vertical inches per minute was found to be necessary for the perfect cleansing of the sand. The strainer system consisted of perforated plates covering concrete channels located at the bottom of trough-like depressions running lengthwise of the filter. The troughlike depressions were filled with gravel, and, to prevent its displacement during washing, wire cloth screens were bolted to the tops of the troughs. These retained the gravel effectively and prevented the passage of sand into the filters, but it has been found that they corroded in certain waters, notably at Cincinnati, and recently they have been removed and the necessity for their use avoided by increasing the depth of gravel above the strainers to 14 in.

Same Results at Lower Cost

The Cincinnati type of filter bottom, while efficient, is quite expensive, and the next step was to secure the same results for a lower cost. The strainer system used at Harrisburg, Pa., consisted of a pipe manifold on the under side of which holes were drilled. The pipe composing the manifold were 1¼ in. in diameter, laid 6 in. apart, and drilled with 7/32 in. holes, spaced 3 in. centre to centre. In this filter air was used for agitation. Somewhat later filter bottoms of the Harrisburg type, in which the use of air was omitted, the velocity of wash water increased, and the gravel layer deepened to 14 in. or more, were used, probably first by Philip Burgess, C.E., of Columbus, O. A similar form used at Toledo and Youngstown, O., both of which plants were built by the Norwood Engineering Company, consists of the ordinary pipe manifold, into which star-shaped strainers of the Wilson type were screwed. The Norwood Engineering Company has always believed in air agitation, and all of their filters are constructed with this end in view. Nevertheless, there is no reason why this type of filter bottom may not be used without air agitation, provided the strainer openings are enlarged, the gravel layer deepened, and the wash-water velocities increased to the optimum for the sand employed.

Inverted Pyramids in Wheeler Filter

The next was the so-called Wheeler filter bottom, consisting of inverted pyramids filled with 3 in. spheres and marbles, covered with a layer of gravel 6 to 8 in. in thickness. A series of channels corresponding to the pipe manifold communicate with the orifices of the respective pyramids. The advantages claimed for the Wheeler filter bottom are the better distribution of wash water secured by uniform material uniformly placed; the absence of metal in contact with the water, thereby increasing the life of the bottom; and its lower cost.

Probably the newest and yet the oldest type of filter bottom consists of a false metal bottom, into which brass strainer nozzles are screwed, spaced 6 in. apart. It is the false bottom of the earlier design, but the strainers with fine openings have been replaced with those having large openings. The gravel layer has been deepened and wash water of high velocity is used. False bottoms of concrete have been suggested and have been built, but the difficulties in the way of the successful design of a tight structure of this kind have caused conservative engineers to avoid it. Furthermore, it is believed that the space beneath the false bottom is a disadvantage, as mentioned above.

Mr. William Wheeler is now building for the Winchester Waterworks Company (Kentucky) a filter bottom having the usual pyramids and balls, but instead of channels beneath the pyramids there is a rectangular space like beneath the filters mentioned above.

Should Wash Sand Without Air

The most generally satisfactory strainer systems are the following:

1. Manifolds, strainers, and a 14 in. layer of gravel.
2. The Harrisburg system of perforated pipes with a 14 in. layer of gravel.
3. Troughs having strainers at their bottoms, with a 14 in. layer of gravel.
4. The Wheeler filter bottom with 7 in. of gravel.

All of these systems should be designed to wash the sand layer without the use of air. Each system has its advantages and disadvantages, but the excessive cost of system No. 3 makes its use inadvisable. There are, therefore, three systems left. Of these system No. 2, the Harrisburg system, is the simplest. It, however, consists largely of metal, all of which is exposed, and at the present prices is probably more expensive than the Wheeler filter bottom. System No. 1, like that installed by most of the filter companies, possessed the advantage over system No. 2, the Harrisburg system, of having the outsides of the pipes protected by concrete. The strainers, however, are exposed, and must be constructed of bronze, which at present prices makes the installation costly, probably the highest of the three. The inside of the pipes are likewise exposed.

In either of the above systems there exist "dead" spaces on the floor of the filter between the openings, where the wash water does not readily reach. This difficulty is overcome in systems Nos. 3 and 4, of which No. 4, the Wheeler filter bottom, is the cheaper. The advantages of the Wheeler filter bottom consist in the absence of metal (with the exception of the short brass tube at the apex of the pyramid); the nearly perfect distribution of the wash water secured by the "ball nozzle" effect of the balls; the lower cost, and the thinner gravel layer. The writer believes that the Wheeler filter bottom is best when placed above channels rather than built as a false bottom of the filter, although to construct the latter is perfectly feasible.

Sand Passing Through Gravel Causes Trouble

Considerable difficulty has been experienced with the Wheeler filter bottom at Akron because of sand passing through the gravel around the walls of the filter, particularly at the corners. The writer has investigated this filter and found that there was a ledge 1 in. wide left around the walls of the filter, and, furthermore, the gravel was composed of 1.5 in. layers and had a total depth of 6 in. It was very difficult for the workmen to spread 1.5 in. layers of gravel evenly in the large units (2,000,000 gallons daily); consequently the sand had passed through the gravel in certain places until is rested on the ledge around the walls of the filter. This sand remained inactive. The difficulty was overcome by increasing the thickness of the gravel layer around the walls of the filter, particularly at the corners. Less than 0.5 per cent. of the area of the filter was involved. This is a very low percentage of sand surface out of action because of lumps, hard spots, etc., and the difficulty can be readily overcome. It would probably be best in a new filter with this bottom to make the gravel layer 8 in. in thickness—namely, 4 in. coarse gravel, 2 in. medium gravel, and 2 in. fine gravel, rather than 3 in., 1½ in., and 1½ in. respectively first used. Where the filter area is small, the thicknesses of the gravel layer may be reduced to those last given.

Wave Action in the Underdrains

In large filters there seems to be a tendency towards wave motion in the underdrains, which may accumulate pressure at certain points in the filter bed, particularly at the ends of the channels, and may possibly cause the rupture of the gravel layer if it be too thin. This statement, of course, applies equally well to the three systems under consideration. The Wheeler filter bottom is better designed to resist jet action from the strainers than are either of the others. The effect of a large ball immediately above the orifice is absolute and unchangeable.

The discussion regarding choice of filter bottom at present centres around the relative merits of the false bottom and the strainer or manifold type. The false bottom was used in only a few plants. The fear in the minds of operators of filter plants is that they may not prove so efficient bacteriologically as a plant designed on the other plan. On the other hand, the false bottom approaches nearer the condition for successful washing—namely, that of a series of orifices discharging from a tank—but with underdrain channels of sufficient size, relative to the areas of the orifices discharging from them, good enough distribution may be secured for all practical purposes, and the dangers, both structural and in operation, which the false bottom presents, avoided. There should be no objection to the use of the false bottom in small filters.

Washing of Filter

Thirty years' experience and the results of experiments by Ellms and others indicate that the successful filter will be washed at a high velocity with water alone. This effect is best secured by a strainer system consisting of orifices, above each of which is placed a layer of graded material to prevent sand from passing out of the filter, either when filtering or washing.

The underdrain system should be designed to throttle the discharge of wash water through the orifices. The latter should be reasonably large to avoid unusual loss of head in the filter, and the underdrains should be proportioned to the orifices. The false bottom system, while cheaper, is not so reliable as the other systems, and there are more or less troublesome results from cast or wrought iron headers and manifold strainer systems, even when they are cheaper, which is rarely the case. The Wheeler bottom, with sufficient gravel, best fulfills the condition of practice. It is, however, on account of its being a patented device, more expensive than the Harrisburg system. On the other hand, it is more durable.

Folder Describes Insulating Brick

The Armstrong Cork and Insulation Company, Pittsburgh, have issued a little folder, "Nonpareil Insulating Brick for Boiler Settings." This folder describes a test recently made on the insulating qualities of Nonpareil brick compared with ordinary brick casing on a 560 h.p. boiler, the test showing that the former saved the equivalent of 296 barrels of fuel oil in one year—more than enough to pay for the brick and the labor required to install it.

Mainly Constructional

East and West—From Coast to Coast

P. Lyall & Son Construction Company announce a dividend of 2 per cent. for the quarter ending September 30.

The building permits issued in Winnipeg, Man., for September number 112 and are valued at $94,800, and the total for the nine months of the year is 1,042, at a value of $2,083,850.

There were thirty building permits issued in the city of Stratford during the month of September at a value of $37,993, as compared with 24 permits at a value of $15,963 in the same month in 1916.

The firm of Thurston-Flavelle, Limited, has been incorporated with a capital of $250,000, head office at Port Moody, B.C. The new company will carry on business as lumbermen, timber manufacturers, etc.

Considerable road improvement work is being carried on in King's County, N.B. Auto trucks and road gangs are at work in different sections of the county and many roads are being widened and gravelled.

In the month of September building permits were issued in Galt, Ont., at a value of $15,410—an increase of $1,505 over the same month last year. There have been no new factory buildings or additions of great importance erected this year in Galt.

Temporary repairs will be made to the docks on the east side of the harbor at Owen Sound, Ont., between Tenth and Eleventh streets, where they caved in following the dredging of three years ago. The work will be carried out under the Department of Public Works.

The Power Development Company, Limited, recently incorporated with a capital of $500,000, has made an application to the Minister of Public Works for authority to construct a dam in the St. Lawrence, near Cornwall, and provide certain compensating works in connection with it.

The cost of the new sewage disposal plant at St. Thomas, Ont., will be $7,543, according to estimates prepared by the city engineer and accepted by the board of works at a recent meeting. The board will recommend to the council that these estimates be accepted and that work commence immediately.

Building permits issued for the first nine months of the year in Chatham, Ont., reach a total of $306,322, an increase over the same period of 1916 of $49,248. A large plant is now nearing completion for the Libby, McNeil and Libby Company, of Chicago, for which a permit will be issued later in the year.

An agreement has been reached whereby the Imperial Oil Company will lease from the Toronto Harbor Board about 4 acres of factory sites, situated southeast of the Don. The transaction is at the rate of $15,000 an acre, and 300 feet of dockage will be leased for 21 years, renewable at $1,500 per annum.

The paving of the Eaton road from the limits of Toronto to the west boundary of the County of York, a distance of 5½ miles, has been recently completed. The first section is a brick pavement 24 feet wide, and the second section is asphalt the same width. This improvement has cost the Toronto and York Highway Commission in the neighborhood of $70,000.

The Department of Public Works propose to proceed at once with work on the rebuilding of the wharf at Oshawa, Ont., for the purpose of making it available for the landing of coal next spring. An appropriation for this purpose was passed in August and it was decided to begin the work in the spring, but it has been found the appropriation will lapse if the money is not used before March 31.

About 2½ miles of bituminous-bound macadam on Yonge Street, in York County, Ont., have been completed, 14 miles to the north of Oak Ridges. The stretch extends from Curtis' Corners to the Grand Trunk crossing, where work has been stopped on account of the necessity of building a subway. It is expected that early in the spring the subway will be commenced and the road will then be extended further north.

The committee of works in the city of Toronto has granted permission to the Imperial Oil Company to construct a large gasoline tank in the Ashbridge's Bay industrial area. The tank will be situated at the mouth of the Don River, 100 yards from the eastern end of the new ship channel. From this tank pipe lines will be laid to the plants of the Consumers' Gas Company on Parliament Street and at the foot of Strange Street.

Under the Ontario Highways Act, about 250 miles of the roads of Elgin County have been taken over by the county commissioners, and repairs will be made at once to the roads, which have been involuntary neglected since the system of good roads has been planned by the county council. Under the Act, the city of St. Thomas will be obliged to improve the streets leading out to the terminals of the rural highways set apart by the council for permanent improvement.

Dewell and Smith, asphalt importers and chemists, of New York, recently invited City Engineer Gray, of Hamilton, Ont., to send a member of the city's road building staff to visit their laboratory and study the methods in use in permanent road building in New York suburbs. The engineer recommends that the council give Mr. E. M. Whitling, the civic road superintendent, two weeks' leave of absence to avail himself of this opportunity to study the latest ideas in asphalt surfacing.

It is reported that enlargement of the locks on the Welland Canal to permit of the construction of bigger ships on the Great Lakes for ocean service is under consideration by United States and Canadian government officials. Shipbuilding facilities on the lakes cannot be employed now to their utmost because large vessels cannot be sent through the canal to the ocean. Some forty vessels of considerable size will be cut in half this fall and sent through the locks, to be put together in Canadian ports for ocean service.

Work on the improvements of the Lower Avon River at Stratford, Ont., has been commenced. The bed of the river is being cleaned so that the stream will confine itself within its banks and clear properly. This is necessary so that the water will not interfere with the retaining wall to be built by the city to protect the main sewer. It is also proposed to construct two dams, at John Street and the sewer farm, and the river will be widened and deepened to make it fit for navigation from the present dam to the cemetery.

Obituary

Geo. McBeth, a well-known Western Ontario contractor, died suddenly from heart failure at Strathroy, Ont., recently. He was 74 years of age.

Mr. William Murdoch, city engineer of St. John, N.B., died suddenly on October 8 of apoplexy. He was born in Paisley, Scotland, 69 years ago. Mr. Murdoch became a member of the Canadian Society of Civil Engineers in April, 1901.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Hamilton, Ont.
Engineering Department, City Council, contemplate construction of watermain costing $8,000, on Wellington St., from Simcoe to Burlington St., and sewer from Cannon Street to Kenilworth Ave., costing $5,000. Engineer, E. R. Gray.

The following are the lowest tenders received in connection with pumping equipment for Beach Pumping Station for City:—Steam turbine pumps and centrifugal pumps, Turbine Equipment Co., Ltd., C. P. R. Bldg., Toronto, Ont., at $52,517 and $22,420; boilers and insulation, Babcock & Wilcox, Ltd., Traders Bank Bldg., Toronto, at $16,950 and $605; motors, Canadian Westinghouse Co., Ltd., Traders Bank Bldg., Toronto, at $16,620; transformers and switchboard and apparatus, Canadian General Electric Co., Ltd., King and Simcoe Sts., Toronto, at $14,010 and $4,990; Venturi meters, Allan General Supplies, 205 Yonge Street, Toronto, at $3,715.

London, Ont.
Tenders received by the clerk, S. Baker, until October 23 for the construction of sanitary sewers costing $18,000 on Eva, Florence, York and Eleanor Sts. for the City Council. Plans and specifications with the engineer, H. A. Brazier.

Oakland, Man.
The Municipal Council contemplates the construction of about sixty miles of highway. Clerk, W. T. Johnston, Wawanesa.

Port Moody, B.C.
City Council contemplate storage reservoir at Cypress Lake. Clerk, W. I. Ferguson.

Prince Rupert, B.C.
The Town Council contemplate extension of watermains at a cost of $10,000. Engineer, Peter Lorenzen.

Sifton, Man.
Municipal Council contemplate construction of forty miles of highway. Clerk, R. H. Hockin, Oak Lake.

Three Rivers, Que.
Tenders received by the clerk, Arthur Beliveau, until 4 p.m., October 22, for the erection of a $12,000 pumping station and reservoir for the City Council. Plans and specifications with the architects, Asselin & Brosseau, 174 Notre Dame Street.

Westbourne, Man.
Ratepayers will vote this fall to authorize the necessary expenditure for 310 miles of gravel highway. Clerk, P. McGregor, Gladstone.

CONTRACTS AWARDED

Chambly Canton, Que.
Laorrain & Daignault, Napierville, have the general contract for watermain 2880 feet long for the Town Council.

New Glasgow, N.S.
Gammon & Weir, Archimedes Street, have the general contract for sewers on Brookside Avenue, Chisholm Street, for the Municipal Council, and will require a large quantity of sewer pipe.

Ottawa, Ont.
O'Leary's Ltd., Bank National Bldg., have the general contract for pavement on St. Patrick St. from McKenzie to the Printing Bureau costing $4,900, for the Department of Public Works, Dominion Government.

Railroads, Bridges and Wharves

Bitter Lake, Sask.
Work will be started shortly on an $18,000 2,000-foot lumber bridge for the Department of Public Works, Province of Saskatchewan.

Les Gires, Que.
Work has started on a $5,000 2½ storey frame station for the Canadian Pacific Railway, Windsor St., Montreal.

CONTRACTS AWARDED

Gagetown, N.B.
M. A. Condon, Water St., Digby, has the general contract for station houses and outhouses costing $12,000 for the St. John & Quebec Railway Company, between here and Westfield.

Public Buildings, Churches and Schools

Galt, Ont.
R. Hall, Barrett-Martin Block, Water St. N., is preparing plans for $10,000 brick isolation hospital for the City Council.

St. Anne de Bellevue, Que.
Tenders being received until November 1 for the erection of a $200,000 limestone and plastic brick hospital for the Military Hospital Commissioners, Drummond Bldg., Montreal.

Scott, Sask.
Plans have been approved for brick Hospital extension for the Hospital Board. Chairman, Dr. Cooper, Main St.

Toronto, Ont.
New tenders will be called for the erection of three lavatory buildings costing $35,000, for the Canadian National Exhibition Board, 38 King E.

Plans have been prepared for five three-storey schools costing $300,000, to be erected by the Board of Education. Secretary-treasurer, W. C. Wilkinson, 155 College Street.

Windsor, Ont.
Tenders are being received by the architect, A. H. McPhail, Board of Trade Bldg., for the erection of a $15,000 one-storey brick Sunday school building for St. Andrews Presbyterian Church.

Fort William, Ont.
The Dominion Plumbing Co., Leith St., have the heating and metal work, and Gough & Co., 1511 Brown St., the plumbing, for $17,500 church for the Ruthenian Congregation.

Fraserville, Ont.
Nap. Dumont has the masonry and J. Charest the carpentry for convent for the School Board.

Montreal, Que.
Lafreniere & Bissonnette, 1713 Masson St., have the electrical contract for $5,000 presbytery for Fabrique, St. Francois Solane, Jeanne d'Arc Ave. The general contractor, A. Champagne, 2185 Blvd. Pie IX, wants prices on seating, fixtures, interior decorations and lumber.

St. Pierre, Que.
G. Archambault, 616 St. Denis St., Montreal, has the general contract for public baths for the Town Council.

Semans, Sask.
Smith Bros. & Wilson Ltd., Eighth and Ottawa Sts., Regina, have the general contract for $10,000 brick school for the Town Council.

Shawinigan Falls, Que.
Trepanier & Bellefeuille, Three Rivers, have the general contract for $50,000 convent for the Roman Catholic Commissioners.

Vileray, Que.
Filion Bros., 2419 St. Denis Blvd., Montreal, have the general contract for church for the Roman Catholic Congregation.

CONTRACTS AWARDED

Fredericton, N.B.
Arthur F. Betts, 315 Queen St., has the plumbing and heating contracts for hospital buildings and alterations to Government House costing between $80,000 and $100,000, for the Dominion Government.

Business Buildings and Industrial Plants

Arnprior, Ont.
Tenders received by the architects, Richards & Abra, 126 Sparks St., Ottawa, for the erection of a one-storey, concrete and brick factory for the Arnprior Cabinet Co., Ltd.

Beauharnois, Que.
Tenders will be called shortly by the architect, G. A. Monette, 83 Craig St. W., for the erection of a factory for the Independent Silk Co., Ltd., 52 Nazareth St., Montreal.

Calgary, Alta.
Tenders have been received for the erection of a $20,000 one-storey brick store building for M. A. Young, care of

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Principal Contents

Architecture No Longer a One-Man Profession

ARCHITECTURE, to meet present-day conditions, must be a highly-organized business and not a one-man profession, as it used to be. This significant statement, from an article by Alfred Chapman, printed elsewhere in this issue, is an expression of a new era that is arising for the profession of architecture. Two circumstances, at least, are directly contributing to this. The first is that modern conditions, especially in the field of industrial endeavor, have made obsolete the small ways of handling big problems. The task of the present-day architect in designing industrial buildings is not comparable to that of many years back. He has to supply the needs of a complicated and intricate organization—an organization that, in most instances, has been developed to a point of high efficiency. This economic situation has required architecture to adjust itself into a highly-organized business that it may cope with the problems of its highly-organized clients.

The need of eliminating the one-man idea in the architectural profession is no less essential in almost all lines of building design, let alone the industrial field. Architecture, like engineering, has become a specialized profession—that is to say, it now involves so many divisions and subdivisions that masters of all are rare. There is the creating and designing, the structural part, the mechanical part, the supervision, and the business and administration, and to cope with all of these there is a call for a business organization of specialists, if a large amount of building is to be efficiently controlled.

Another reason for the passing of the one-man idea lies in the competition being met by architects from large building organizations which perform architectural as well as contracting services. These large corporations are gaining ground because they have every facility for financing construction. Mr. Chapman regards the intentions of such companies as purely mercenary, and thus opposed to the interests of good design. He says: "It can easily be seen that the building corporation's interest being to sell an article at a profit, they are not going to obtain the best possible solutions of the problem unless it is to their monetary advantage to do so. . . . Undoubtedly, then, if building gets into the hands of business corporations whose sole interest is profit, architectural design will not arrive at the development which it would if controlled by the architect whose object should be to lead the client to the best solution of the problem in hand."

Whether this is so or not, we cannot get away from the fact that such corporations are competing with architects to the latters' detriment. If the architectural profession is to be maintained on the same basis as heretofore, it means that the profession must be organized. It will have to adjust itself into a business proposition if it is to successfully compete with these new conditions.

Public Contracts on Percentage Basis

AT a special general meeting of the Montreal Builders' Exchange, Mr. R. F. Dykes presiding, the subject of government and public contracts was discussed. Mr. W. E. Ramsay brought up the question, and referred to the difficulty of securing structural material. He moved that the exchange go on record as favoring the policy that all government and public contracts be given out on a percentage basis until prices of material and labor be re-established on a normal basis. Mr. J. Wighton seconded. Mr. J. Hand opposed, on the ground that by this method there was a danger of contracts falling into the hands of a few contractors, while Mr. J. White declared that it was likely that the amount of percentage to be paid might be fixed by the strength of political pull exercised. The motion, however, was carried by a majority.

The chairman, in referring to the work of the past year, spoke of the improvement in the lien law. Mr. Ramsay remarked that the existence of the exchange was alone justified by the action taken in this matter, and that if the act were put into operation by the trade generally it would ultimately lead to the elimination of dishonesty.

Mr. D. K. Trotter, the secretary, stated that the Hon. H. L. Taschereau, Provincial Minister of Public

Works and Labor, was desirous of obtaining the views of the exchange should the government deal with amendments to the existing workmen's compensation law.

The members also discussed the civic government of Montreal, admitted to be unsatisfactory, and the secretary was instructed to draw up a resolution, to be submitted for approval to the directors, and afterwards presented to a special general meeting of the members.

Saskatchewan Branch, C.S.C.E.

THE regular monthly meeting of the Saskatchewan branch of the C.S.C.E. was recently held at the Assiniboia Club, in Regina, in connection with the monthly dinner. Action was taken on a resolution passed by the Joint Committee of Technical Organizations (Ontario branch), which had forwarded a petition to Sir Robert Borden and the Minister of Militia asking that men be drafted into the branch of the service for which they are most nearly fitted by training and experience. The Saskatchewan branch did not think it advisable to approach the government directly, but only through the medium of the council of the parent society at Montreal, similar action having already been taken by the Calgary branch.

An advisory committee was selected, with one representative of each branch of the engineering profession as a member. There are sixteen members in all, each the most prominent man in his specialty, such as bridge builder, civil engineer, concrete engineer, etc. The duty of this committee will be to assist all members in the province in an advisory capacity and also act on national or provincial engineering matters as a body of consulting engineers.

A provincial library has been started, for which donations from Sir John Kennedy, the parent society at Montreal, the Dominion Government, etc., have been received and promised.

The matter of the meeting of all Western branches of the society, to be held in Saskatoon in 1918, is well under way, a special committee paying particular attention to all details. The Saskatchewan branch also decided to send a congratulatory message to the Quebec Bridge Company upon the completion of the bridge.

A paper on "Halifax Ocean Terminals," depicting the large undertaking, concluded the evening's program.

Germany Plans to Reconquer Markets

THE British Clayworker prints an interesting item throwing some light on the already active propaganda in Germany towards recapturing trade after the war. Evidently they are more or less appreciative of the difficulties they will encounter, but with characteristic stolidity they see nothing in it that cannot be overcome by sufficiently aggressive "universal" propaganda. The following quotation from a Munich paper indicates their confidence in reconquering the markets lost during the war and making commercial Germany "again" supreme:—

"The representatives of German industry and German work must be made to regard themselves not as the representatives of a firm, but as agents of the German National Idea, and to develop their activity into a propaganda for the prestige of the German name. A few days ago there was a demand in the British House of Commons for a Bill to prevent Germans from carrying on business in England after the war. Where such a spirit prevails a whole army of propagandists is required to fight it down. This army must be provided by German trade itself. It is no longer a question of the representation of private interests; we must organize a Universal Economic Service which, through peaceful competition, will reconquer for us the markets which we may have lost by the war. It will not be an easy task, but if we employ our whole strength and best men we shall gradually succeed in overcoming the barriers raised by England. Then we shall again be supreme, even in the very places where hatred and jealousy desires to cut us off from world commerce."

Bloor Street Viaduct Progress

SHOULD no unforeseen circumstances arise, both the Don and the Rosedale sections of the Bloor street viaduct, Toronto, will be completed and handed over to the city by November 1. The remainder of the work, the laying of the rails and the pavement, is to be done by the city, but it is understood that this will not be undertaken until next year, so that the viaduct may not be open for traffic before next summer. The contract time for the completion of the Don section is December 24, and as the contractors will have completed their work considerably before that date they will claim the stipulated bonus of $25 per day.

The progress on the bridge is recorded in a report prepared by Commissioner of Works R. C. Harris, as follows:

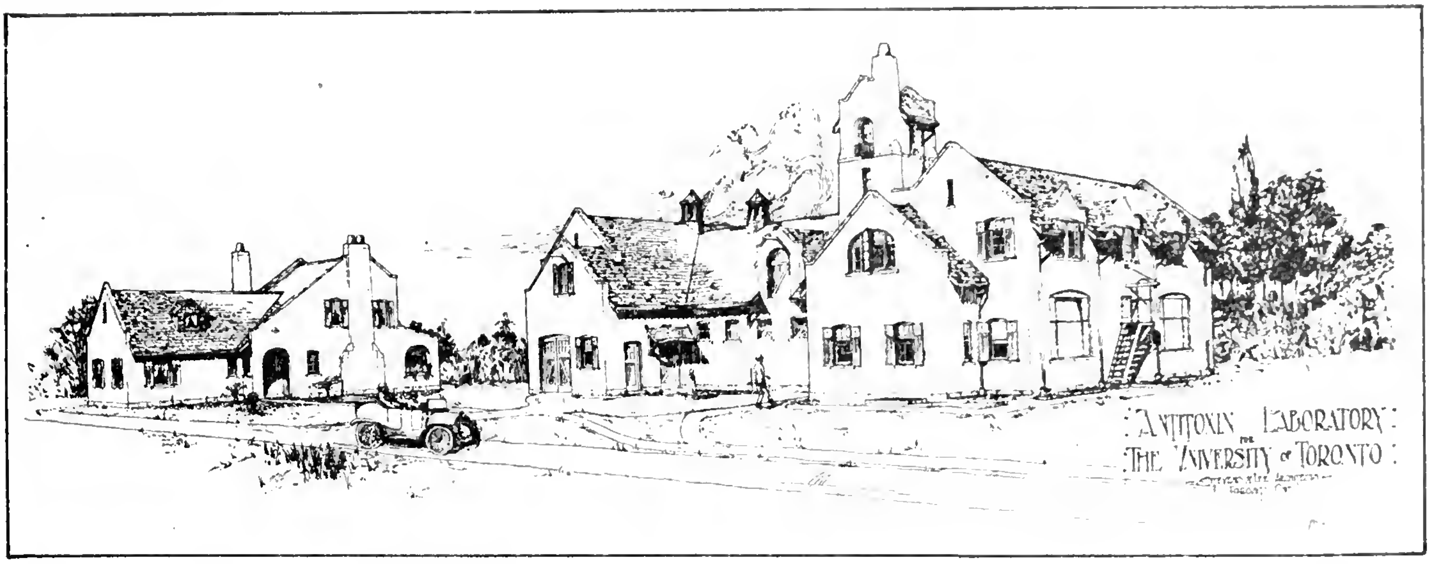
Bloor street section.—Approximately 30,000 cubic yards of earth is still required to complete the fill. After this has become consolidated the tracks, overhead construction, roadway, sidewalk, drainage, and lighting will still have to be completed.

Rosedale section.—The contract for the Rosedale bridge is completed, the tracks laid, and paving partially done. Temporary macadam approaches have been constructed connecting the bridge with Castle Frank Road, and the intersection of Parliament and Howard streets. This bridge can be used for traffic in a short time.

No work has yet been done on the portion of the roadway between the approach to Castle Frank Road and the west end of the Don bridge.

Don section.—The contract for the bridge is now nearing completion, after which tracks, overhead construction, paving, drainage, and lighting will have to be installed to finish the bridge. From the east abutment of the bridge to Broadview Avenue no work has yet been done. Recommendation for a local improvement pavement has passed the necessary stages, and sidewalk for the north side is ready to advertise for. Track allowance work will be carried out in conjunction with the work on the bridge to the west. This work, it is expected, will be completed next year.

Financial status.—The amount of the appropriation, less debenture discount, is $2,215,000; the amount already spent is $1,675,600, leaving a balance of $539,400 available for the work yet to be done. The whole of this amount will be required to finance both the construction work and the purchase of the necessary land and land damages.



New Laboratories of Toronto University

Unique Institution, the Only One of Its Kind in Canada Has Molded Public Health Policy—Details of Construction and Equipment

TO-MORROW will witness the official opening of the Connaught Laboratories of the University of Toronto, located at Fisherville, about ten miles north of Toronto. This institution is unique in that it is the only one of its kind in Canada. It may even be said to stand alone among similar institutions on this continent, since those on the other side of the line are largely commercial enterprises, manufacturing the laboratory products for profitable sale. This University of Toronto laboratory, on the other hand, is making its output available largely without profit, solely in the interests of better health and as a patriotic measure.

The purpose of these new laboratories is to manufacture medical serums and antitoxins and other biological products of a preventive or curative nature and to distribute these free or at a nominal charge. This institution, the most up to date of its kind, is the gift to the university of Col. A. E. Gooderham, a member of the executive of the Canadian Red Cross Society. A fifty-acre farm, in connection with the laboratory buildings, provides the best possible conditions for the care of horses and other necessary laboratory animals. As H.R.H. the Duke of Connaught has been interested in the work, he has consented to the institution being called the Connaught Laboratories of the University of Toronto.

Supplies Canadian Forces

The new building will provide adequate facilities for the work, which has hitherto been greatly hampered by lack of accommodation ever since the establishmnt of the laboratory in May, 1914. At the present time the work at the laboratories is being concentrated largely on supplying war needs. For some considerable time all the tetanus antitoxin required by the Canadian Expeditionary Force has been supplied by the laboratory, at a price lower than the lowest price quoted by any American manufacturer of the antitoxin. The laboratory has, further, had considerable influence in moulding the work of the public health departments, since as soon as it was established every encouragement was received from provincial and municipal boards of health. Arrangements were made for distribution of various antitoxins and serums at reduced prices or free of charge. The decision of the Ontario Board of Health to supply vaccines and antitoxins free has placed Ontario in the van in public health work. The outbreak of war increased to a very great extent the work of the institution, and it was on this account largely that the new building was constructed and equipped.

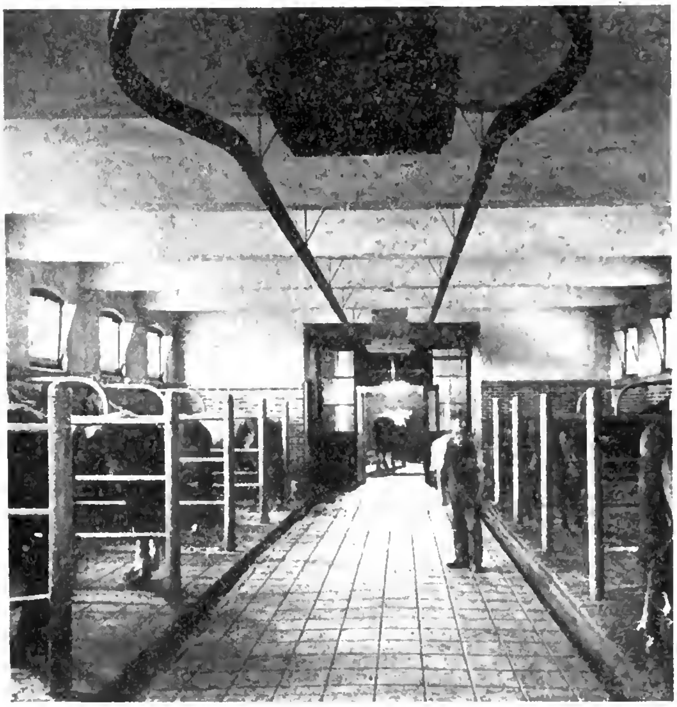
The establishment of such a laboratory has been justified according to Dr. Fitzgerald, its director, firstly, because no country in the world of the size of Canada is without laboratories for the purpose; secondly, the supply may become insufficient at any time, as indicated at the outbreak of war; and, lastly, for economic reasons.


Main building of laboratory.

Adapted to Special Work

In the matter of design and construction, in which the readers of the Contract Record are more intimately interested, the buildings show nothing of any unusual character, except an adaptation of the facilities to suit the purpose and work of the institution. As the laboratory is for the manufacture of antitoxins and serums which are biological products, the building must include housing accommodation for animals, as well as purely laboratory arrangements. Owing to its distance from the city of Toronto, there are also residence facilities for members of the staff. The design is also such as will offset the purely utilitarian, and give the buildings an atmosphere of attractiveness, in keeping with the location and rural surroundings.

In general the lay-out comprises a stable portion on the ground floor, with stalls separated by stall partitions of pipe rails set in cast-iron newels. The stalls are provided with feeding basins, etc. Along the centre aisle a manure trolley and carrier is installed. The operating room, where the horses are bled, a cold storage room and laboratory are also included on the first floor. The second floor is largely a hayloft, with accommodation in one wing for such animals as rabbits and guineapigs, while the other wing is fitted with



Building is of fireproof construction with concrete floors on steel beams fireproofed with concrete.

complete living quarters for the superintendent. The basement contains boiler-room and storage facilities, and houses the pump, refrigerating machine, and electric generator.

Main Building Is Fireproof

Two buildings are included in the institution — a main laboratory building and a cottage for residence purposes. The main building is fireproof, with the exception of the roof. It is a two-storey structure, measuring about 103 ft. long over all, 30 ft. wide in the centre portion, and 60 ft. wide at the end wings. Under one end wing only a basement is provided. The foundation walls are of stone, 18 in. thick, on concrete footings, the stone being carried up to about 1 foot above grade. The walls are of Denison interlocking hollow tile, laid in cement mortar. On the west side brick is used to the window-sills, with tile above that. All of the tile is covered with a plaster, applied directly to the tile without studding. The roof is the only part of the building that is non-fireproof. It is of the conventional slate type on 2 x 8 and 2 x 10 in. joints and 7/8 in. sheeting. Interior walls and partitions are of hollow tile and fireproof, excepting a few partitions on the second floor, which are of wood.

Concrete Floors

The floor of the second storey is carried on steel beams, those spanning the stable portions being I-beams 18 in. deep and those on the end wings 10 and 12 in. Bethlehem shapes. These sections bear on steel bed plates in the tile walls. The floors are of concrete, reinforced, and the I-beams are fireproofed with concrete. The floor slabs are 4 x 4½ in. thick. In some rooms suspended ceilings have been employed to cover the I-beams. These are carried by hangers, imbedded in the concrete floor slabs.

One feature of the building is the arrangement made to secure sanitary conditions. The walls in the stables and laboratory rooms are lined with a glazed brick dado, which can be easily kept clean. All internal angles are coved, so as to avoid dust-catching conditions, and all corners are bull-nosed. In certain of the living quarters the tile walls are plastered instead of being brick-lined.

Three ventilators are provided, which are of the sliding counter-balanced type, arranged so that they may be pulled down to remove the foul air close to the floor. The tower houses the water-storage tank, and is made an architectural feature of the buildings.

The cottage located close to the main building is constructed with Denison interlocking tile walls, plaster-covered, but the floors are of the ordinary joist type and non-fireproof.

Artesian Water Supply

A water supply is derived from artesian sources through a well. Storage is provided in a tank located in the tower, with an electric motor-driven pump in the basement to pump the supply. A concrete septic tank takes care of the sewage, the effluent being distributed through the soil by a system of drain tiles.

For heating, two low-pressure steam boilers are located in the basement of the main building, with pipes underground to the cottage.

Self-Container Lighting Outfit

The laboratories are self-contained so far as the lighting equipment is concerned. A Lister-Bruston automatic electric lighting plant is provided, which comprises (1) engine and generator, (2) switchboard, and (3) small storage battery. The generator is driven through a semi-flexible coupling by a two-cylinder, water-cooled, slow-speed gasoline engine. It is of the automatic, self-starting and stopping type, the current being taken from the storage battery to turn the armature of the generator in starting. The storage battery, of 80 amp. h. capacity, supplies lights up to 10 per cent. of the maximum capacity. When more lights are in service the generator is automatically started and continues operation until all but a few lights are required. The switchboard is of slate, and contains the requisite appliances for the operation of the outfit. The capacity is 4.8 kw. at 110 volts. In addition to supplying light for the main laboratory and cottage, the storage battery supplies the motor-driven pump for the water supply. The ammonia compressor machine in connection with the refrigerating system is driven by belt from the engine. The equipment was supplied and installed by R. A. Lister & Co., Ltd., Toronto.

The cold storage room, 13 ft. x 11 ft. x 12 ft., is provided for the retention of the serums. In the basement is installed an ammonia compressor plant, supplied by the Linde Canadian Company, Toronto. This operates on the direct expansion system, and maintains a temperature of 40 degrees in the cold room. The compressor is driven by belt from the shaft of the lighting unit. Under ordinary circumstances, it is operated only four hours per day. To equalize the temperature in the refrigerating room during the period when the compressor is not in operation hold-over tanks are installed. These are brine tanks, through which ammonia coils pass. The refrigeration equipment also operates in connection with two small ice boxes, one in the second storey of the main laboratory and the other in the cottage.

Architects and Contractors

The architects for the laboratory were Messrs. Stevens & Lee, of oronto. The general contract was carried out by Holtby Brothers, Ltd., Toronto. The following were sub-contracors: Hepburn & Disher, Ltd., structural iron; Eberhard-Wood Manufacturing Company, ornamental iron; George Sparling, carpentry; R. C. Dancy & Sons, plastering; George Duthie & Sons, Ltd., sheet metal; cold storage room, John Hillock & Co., Ltd.

Initiative Lacking in Architecture

Failings and Achievements of Present-Day Design—Prospects for the Future — Paper Read Before R.A.I.E.

By Alfred Chapman

We are in the position to-day of knowing more about the science of building than has ever been known in any previous architectural era. We may possibly know more about architectural design in its broader sense, but we do not know more about the aesthetic side of architecture—that is, the effect upon the senses and emotions.

When I say we may possibly know more about architectural design, I have in mind our great versatility in handling more or less intelligently anything from a skyscraper to a bungalow, or from a mantel to a cathedral, and we can dress these creations up in a Mission, Classic, Renaissance, or Gothic character. We can also make the building fit the practical requirements of the organization to be housed, and give the building a character that more or less suggests its utilitarian purpose. We realize to-day, as we never realized before, the importance of this element of giving expression to the innermost character of the function a building serves rather than giving it a conventional, and to a certain extent meaningless, architectural expression. We have also a conception of what planning means that has in it the germ of a far-reaching development. This is clearly seen in the plans submitted for some of the more recent competitions, such as those held for the Government Buildings at Ottawa and the Winnipeg Parliament Buildings, where arrangement and proportion shown in many of the plans are far beyond the conception held a few years ago.

No Initiative in Present-Day Design

When we come to the aesthetic side of architecture, by which I mean that element that raises the science of building to the same plane as the great arts of painting, music, and sculpture, we have only to consider our dependence upon the great architectural epochs of the past to realize our weakness. How many architects of to-day could, without the assistance of their libraries, design a building with the classical beauty and refinement of a Parthenon, or with the robust and simple treatment of the Baths of Caracalla, or a building with the imaginative aspiration of a Rheims or Rouen Cathedral, or, again, with the luxurious and clever composition of the Louvre? If we regard the fine poetic sentiment in the English Gothic collegiate or residential work we must realize that this sprang from a deep sincerity and feeling in their work that architects of today are far from possessing. We cannot design on our own initiative with the perfection of any of these masters, but we have, as before mentioned, a remarkable versatility in producing a semblance to all of them; furthermore, if we wish to copy them slavishly we can reproduce them with the assistance of an extensive library, but this, after all, is archeology, not living architecture.

This is what appears to me to be the position we are in at present; and now let us trace the steps by which we have arrived at this stage, after which I would like to consider certain elements affecting our further development.

Solidity and Dignity Sixty Years Ago

About sixty years ago most of our best work was done by men who were trained in England, and who brought with them a sincerity and conservative restraint in their work which resulted in a dignified and sober treatment of Classic or Renaissance buildings, and a sincere treatment of Gothic that showed a familiarity with the better class of English work. Residential street architecture was treated then with more urban dignity than in the years following, particularly in Toronto. This is a curious anachronism, for consider how small the cities were at that time compared with what they are now. Our business districts were built up more substantially and with more dignity, all of which expressed the effect of the solidity and thoroughness of English traditions. Architects of this period, however, kept carefully within bounds, and did not indulge in flights of imagination or attempts to solve new problems in new ways, and the school from which they drew their inspiration was rather dogmatic and limited, though sound and safe as far as it went.

As this period gradually passed and the flow of prosperity, occasioned by our rapid growth, spread over the country, we seem to have broken away from the influence of earlier traditions. The rapid expansion necessary and the limited amount of capital to meet this expansion led us into less thorough methods of construction and less careful designing. Owing to there being no restraint upon the practice of architecture other than the rather uncertain discretion of the public, we naturally find at times like these many practising architecture who had not sufficient training or equipment, and this state of affairs led to a lowering of the standard and created the darkest architectural period of Canada's career. This flow of prosperity and building activity, however, died down, and Canada became subject to a good many years of depression, in which there were not a great many buildings erected.

What About the Future?

In the earlier part of this century Canada began to realize its great future and to waken up and go ahead by leaps and bounds, and the building expansion following assumed enormous proportions. This period gave birth to higher architectural aspirations, due probably in a large measure to the great architectural development of the United States, which, in itself, was due to the European training which led to the handling of problems in a freer and broader spirit, and also led to a more penetrating study of the old work.

Undoubtedly, the development we have undergone in this last era of building activity places us farther on the road to architectural proficiency than we have ever been. We have more of a grasp of the real architectural problem, and we realize that the main element to be sought is a successful plan, and next to that an expression that leads the mind to grasp the essential character of the organization clothed by the building. We are emancipated from the necessity of cramping the problem to suit a preconceived design. When we compare, for instance, a modern station, office building, bank, library, or school with the buildings housing similar organizations fifty years ago, we realize that we have developed a much broader grasp of the problem, but this ability is, after all, only elementary, and leaves us on the threshold of a really great architectural era. Are we going steadily forward in the great building expansion that is bound to come to Canada sooner or later, or shall we blunder along in a mediocre way? I think the threshold upon which we have stepped is also a cross-roads. There are some alarming factors in present-day conditions which make me think the choice of roads at this juncture is of vital importance to our future architectural development.

Architecture No Longer a One-Man Profession

The days of handling a large architectural practice in a small professional way are past. Consider the organization that is required to efficiently control a large amount of building under present-day conditions. First, there is the business and administration; then there is the structural part, the mechanical part, the supervision; and, finally, the creating and designing—in short, an efficient organization to create and purchase an article or articles totalling in value of perhaps a million or so dollars a year. We have not many of these organizations in Canada, but we will have in future years; and, what is more, to-day we have to meet the competition of such architectural organizations in the United States, and also of large building corporations encroaching upon the architects' province. This means that architecture, to meet present-day conditions, must be a highly-organized business, and not a one-man profession as it used to be, and I believe that this is a tendency growing out of modern economic conditions that cannot be altered.

The fact that we have to consider is its influence on architectural design. Such a development as the above means specialization and extreme proficiency in design, and this means at least ten years of training under the best of advantages. There are many in the United States being trained to fulfil these modern requirements in the way of design, but practically none in Canada. Our opportunity for training men is at a very low stage. We have not the control over the students that the old system of indenture gave us, and we have no ateliers like they have in the States, which make an excellent substitute for the former system. It is true we have our architectural colleges, but they only carry the student a short way along the road he has to go. In view of this, I venture to say that the head designers in the largest offices in Canada ten years from now will not be Canadian-trained men, and probably not Canadians, unless more action is taken in an educative line immediately after the war.

Danger in the Control of Building by Corporations

There is a very serious aspect to this question of the necessity of strong organizations to cope with the modern building conditions, and that is if architects do not organize to meet these conditions large building corporations, with every facility for extensive capitalization, will. In considering what effect this would have upon design, it can easily be seen that the building corporation's interest being to sell an article at a profit, they are not going to obtain the best possible solution of the problem unless it is to their monetary advantage to do so, and it is only to their advantage to sell an article that in a general way meets the requirements of the purchasing public. Although I believe the understanding of the intelligent public is the mainspring of all great developments in art, this understanding is generally subconscious, and it is the artist's work to tap the spring and develop it. This means conscientious pioneer work, which would never be to the interest of a building corporation to undertake. Undoubtedly, then, if building gets into the hands of business corporations whose sole interest is profit, architectural design will not arrive at the development which it would if controlled by the architect whose object should be to lead the client to the best solution of the problem in hand, even if he knows his efforts may not be appreciated for several years to come. We have only to consider the increasing control of large building operations by corporations on this continent to realize that this is not an imaginary but a real danger to the existence of architecture as a great art. By maintaining the highest ideals and by educational facilities and a broad spirit of organized work, together we can maintain control of the situation and the spur of the danger, above mentioned, should accelerate the development of architectural design.

We can hardly hope to realize to the full our present ideals for a decade or more, even if we rise to meet the conditions referred to above. The training of the senses for pure beauty in form, rythm, and color can only be accomplished by years of constant effort, backed by great enthusiasm, and this, in itself, needs to be sustained by the intelligent appreciation of the public whom we serve. To cultivate this appreciation of the public, which is the solid foundation of all art, and also to devise means whereby it will be satisfied within the bounds of Canada, seems to me our present-day duty, to which we should devote our energies.

Discussion

In the course of a brief discussion Mr. Chaussé mentioned that, as architect for the city of Montreal, he recently received a letter from a large American corporation asking if he knew anyone in Montreal desirous of having large buildings erected. This corporation said they would furnish the plans and everything, and would help secure the necessary money for the construction.

Mr. Smith—That is a rather strong lever they have.

Mr. A. F. Wickson remarked that the paper pointed to considerations which Canadian architects would have to meet in the future.

Mr. Taylor said that if people wanted large buildings erected they were apt to go to these building corporations.

Mr. Wickson replied that people would not go to such corporations if the architects were organized to meet the conditions. He did not know whether it was purely a matter of imagination on the part of the public, but they seemed to expect that such organizations referred to by Mr. Chapman were really necessary. As a matter of fact, no architect or architectural firm today undertook to do everything. It was waste of time and of energy attempting to do the engineering part of the construction of a large building, and one naturally engaged an engineer to do it. A firm simply called in a specialist in connection with the mechanical part of it; the difficulty was to get the public to realize it. Their Canadian clients were half afraid to go to a Canadian architect, feeling, perhaps, that he had not the same organization as some of the American firms had, not realizing that the Canadian had the organization, but in a different shape.

Waterworks Problems

Presidential Address Before New England Waterworks Association Outlines Some of the Problems Confronting Waterworks Executives

THE matter of supplying water is of a different character from that of any other municipal industry. All others primarily are disbursing agencies handling allotted funds. Their principal duties are to see that their funds are honestly and economically expended on pre-determined work. The water department, on the other hand, is always a commercial enterprise, similar in many of its requirements to other public utilities, as, for example, the business of furnishing light and power by gas or electricity and the running of steam and electric plants. Here there is a question both of production and distribution, with new problems continually arising as to methods of operation and maintenance. Economical and efficient means must be employed to produce an article that will satisfy customers and be delivered to them at fair rates. The plant must be operated in such a manner as to be at least self-supporting. Thousands of consumers must be handled individually with the same regard as obtains in the best-conducted retail trade.

Essentials of Management

To-day something more is required of the waterworks executive than to be able to get 480 minutes' work for the price of labor, properly to lay pipe and quickly to repair a break in a supply main. These things are necessary in carrying on the department work, but they are not the essentials of present-day management. The waterworks executive must be familiar with all these, but, in addition, he must have intimate knowledge of and ability to handle such financial questions as valuation of works and equitable rate-making, as well as hydraulic problems relating to supply and construction or the complexed questions involved in providing a water which satisfies modern standards.

Intelligent systems of accounting are necessary. Rules and regulations adjusted to present conditions are required. Scientific purchase of materials and supplies, cost keeping that instructs, modern transportation, checks on the care of department property, and similar matters, are all part of the organization of even the mediocre construction company. How can water department business succeed without them

The question of revision of rates to meet existing conditions is most vital to successful operation, but one which is often the last to be taken up, particularly in municipally-operated plants. Many rate schedules now in use even in our larger cities are inheritances of the past, continued because of the inertia of the present. Some of these are ridiculously inadequate, and fail utterly to recognize conditions of plant, cost of operation, and special value to different classes of users. Such conditions result in extravagant operation and in ineffectual service.

Filtered Water Supplies

At the present time it is the trend of opinion, based on judgment of the best sanitary specialists, that all public water supplies sooner or later must be filtered. Water is demanded which is clean and attractive, with freedom from pollution, removal of turbidity and color, reduction of chemical constituents producing hardness and other detrimental conditions, and the elimination of taste and odor.

These are some of the problems of the modern waterworks executive. Properly met, they mean efficiency in organization and economy in operation, with consequent benefit to the city. To do these things it is necessary that the manager of the water department shall be able to grasp, understand, and control adverse conditions which were formerly accepted as inevitable but are now known to be amenable to remedy, if not cure.

Until many of our manufacturers and consumers, on the one hand, emerge from an attitude of pigheadedness and, on the other, step aside from a position of cock-sureness, there will be difficulty in meeting the demands of commercial enterprise and construction possibility. Opportunity is hindered by ignorance and the effect of the small mind, unable to comprehend the standpoint of the other fellow. The talisman of success is co-operation. Manufacturers must concede the necessity and be willing to consider with open mind changes in plant, though expensive to them, if efficiency and economy result in construction work.

Engineers and users of manufactured products must recognize business exigencies and matters affecting established industry. They, too, must have the open mind which is free from personal bias, broad in its outlook, and dispossessed of a finicky attitude.

Use Labor-Saving Tools

In these days the direction of the force of gravity as regards cost of labor and materials appears to have been reversed. An efficient way, and perhaps the best way, to meet this condition seems now to be the more general use of labor-saving tools, careful selection of materials, more thoughtful planning of work, and better organization force. Present prices of labor and materials in many cases are beyond that ever before experienced, and the outlook into the future seems to reveals little or no downward tendency. For a short period there seemed to be a faltering in construction work, but contract news, construction advertisements, and bond sales indicate recovery, with a tendency to accept present prices as better perhaps than will be afforded later. From this viewpoint, more and more public work of considerable magnitude is being let.

Munitions Manufacture in Canada

Address Before Opening Meeting of C.S.C.E. Gives Data on Production of Shells and Explosives in the Dominion

BRIGADIER General Sir Alexander Bertram read a paper on the "Manufacture of Munitions" at the opening meeting of the winter session of the Canadian Society of Civil Engineers, Montreal. The lecture was illustrated by a large number of moving pictures showing the entire process of manufacture.

The paper stated: Many of my fellow members can go back with me forty years when in Canada there was practically no basic industry beyond that of agriculture. Its provisions were so many practical devices for warding off the ailments of our infant industries. There were far-seeing men in those early days who knew of the great natural resources of our broad Dominion and who visioned what has come to pass. Yet is was the holocaust of war which has really made Canadians know Canada. Through the fiery furnace of the great conflagration we have been brought to the actual realization that the visions of our forefathers were not the dreams of speculative optimists.

That we had more than a country of magnificent distances and that even our mountains and rock-bound coasts were mines of infinite wealth was admitted in a general way within the present decade. Practical men like you whom I see before me can realize the difficulties, or some part of them, which confronted the men who first tried to organize and convert our great metal deposits into an efficient machine for the supply of munitions to the British Empire and our allies.

Out of the chaos and crime of this awesome war Canada has learned that her natural resources are now actual and active, and that she has contributed the three great essentials of war—men, money and metals —in generous quantity and in superb quality. That we shall benefit from this development in years to come is what you must know and feel.

Output of Shells Would Build 19 Quebec Bridges

Let me preface the figures which I am about to give you. We have shipped in shells sufficient tonnage to build 19 bridges across the St. Lawrence, each bridge equal to the size of the Quebec Bridge. We talked a few years ago of contributing three battleships; our tonnage in shells shipped to the Empire would build 66 battleships of 18,000 tons each.

In this paper we deal only with munitions. What Canada has done and could do could be written in other chapters of industry. It is my purpose, however, to give a talk on the manufacture of munitions in Canada, and also to place before you a statement of the quantity of shells and the weight of materials in steel, copper, spelter and lead required to complete the orders given by the British Government.

The introduction of the refining of copper and spelter is a new industry in Canada. The Consolidated Mining & Smelting Company, of Trail, B.C., are producing 300 tons of copper, 1,700 tons of lead, and 1,200 tons of zinc per month. This taxed the capacity of all our steel producing and refining plants. There were also new plants organized for the manufacture of all kinds of explosives which will be enumerated.

Old and New Shipyards Working Day and Night

Concurrently with the carrying out of the production of munitions, the Imperial Munitions Board were given large contracts for the manufacture of ships of all sizes. Few men but those who live by the lake and sea know that huge contracts for ships are being carried to completion daily, and that every old shipyard and many new shipyards are working day and night. The component parts of ships are all made in Canada, with the one important exception, we have to import all the rolled plates for the steel ships. It only requires this one industry to balance up the component parts of shipbuilding. I am pleased to state that this is now under serious consideration.

The manufacture of aeroplanes was introduced about eight months ago and today is an excellently developed organization, producing upwards of 100 aeroplanes per month. Plans are being put into operation to double this output immediately.

Production of Factories

In addition to this the Board have established plants for the manufacture of nitrocellulose powder, t.n.t., and cordite. The production of these factories are:—

Shell	Quantity	Tons
18 pr. shrapnel	27,931,714	189,556
18 pr. high explosive	5,300,908	71,559
4.5 in. high explosive	8,738,470	235,893
60 pr. high explosive	1,097,317	48,281
6 in. high explosive	2,959,626	233,310
8 in. high explosive	747,190	113,106
9.2 in. high explosive	744,179	168,155
	47,519,404	1,029,860

Cartridge Cases	Copper and Brass
18 pr. cartridge cases	30,188,904
4.5 in. cartridge cases	9,466,523
	39,655,427 or 20,768 tons

Shell Forgings Exported	
18 pr. Shrapnel Forgings	447,112
4.5 in. h.e. forgings	3,574,214
6 in. h.e. forgings	899,711
	4,921,037 or 138,498 tons

Propellants and Explosives
British Chemical Co. produce:
T.N.T. about 40,000 lbs. per day.
Nitrocellulose.
Powder, about 80,000 lbs. per day.

Manufacture of Explosives

Approximately 46,000,000 lbs. of T.N.T. have been manufactured since the commencement of the war. The number of boxes required for all sizes of shells and explosives runs to about 25,000,000.

Cordite.—The production of the British Cordite

Company will reach in the neighborhood of two million pounds per month.

Time Fuses.—This was also a new industry, and plants were organized for this purpose, and when operating at full force they produce 40,000 time fuses per day.

Acetone—One plant was volunteered for this purpose and is today producing over 100 tons per month. It is a model of perfection.

Electric Steel.—When a year ago there appeared to be a shortage of steel the Board established an electric steel plant for the purpose of utilizing the scrap material. This plant is almost completed, and today is producing steel for the British Government. They expect to reach approximately 4,500 tons per month.

Purchases Total $700,000,000

The total value of all munitions and supplies purchased since the inception of the shell making industry from September, 1914, to September, 1917, is approximately $700,000,000. The work carried on embraces no less than 400 factories and plants in the Dominion, three-fifths being directly associated in the production of shells, and two-fifths associated with the production of components, basic supplies, and shipbuilding.

The object, from the inception of the manufacture of these shells was to produce the finished article from the raw materials found in Canada's own mills and mines. This has been done. The shells have been made in Canada from fuse to cartridge case.

The Imperial Munitions Board has accomplished a great work in the present and has presaged a great future for the industries of Canada. When the history of their accomplishments may be written, when stories of how they have had to surmount adverse conditions may be told without reservation, then only will you know as I know what a magnificent and stupendous work has been carried out for the benefit of and for the future of the Dominion of Canada.

373 Ships to Carry the Shells

Mr. J. Duchastel, who presided, supplemented the paper by the following statement: A better appreciation of the volume of muitions supplied by Canada to the allies will be had when one realizes that if one ship a day were loaded with 3,000 tons it would take 373 ships, or one every day for a year and eight days, to carry the shells alone across the ocean.

This cargo would load 39,637 freight cars, which, if coupled end to end, would make a string of cars reaching from Montreal to Toronto and an additional line from Montreal to Ottawa.

The steel used in making shells if rolled into 90-lb. rails would build two transcontinental railways from Halifax to Vancouver.

If placed end to end the boxes in which the shells were shipped would make a single line from Victoria, B.C., to London, Eng., with sufficient left to be placed three abreast reaching from London to Berlin. These boxes when piled solidly in St. Catherine Street, Montreal, would fill it from wall to wall to a height of 50 feet, a length of four miles, and if built solidly on Dominion Square, covering the entire portion of the square below Dorchester Street, would make a solid cube reaching to the height of 1,750 feet.

Labor Demand Predicted Beforehand

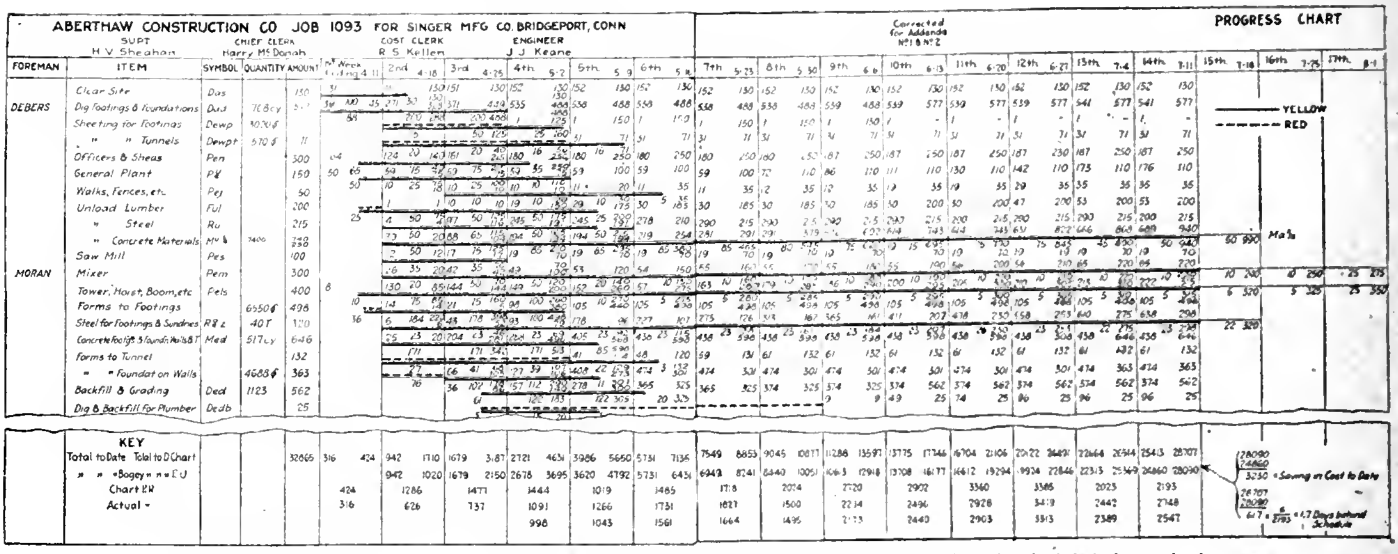
Charts Enable Construction Company to Determine in Advance Weekly Payrolls at Any Stage of the Work

In seeking a record of a job's actual cost in time and money as compared with the progress schedule made for it in advance, the Aberthaw Construction Company has modified its methods somewhat, so that it is possible to tell in advance how much weekly payrolls must amount to at each stage of the work; to tell, moreover, not only whether the material progress is up to this schedule on any date, but exactly how far behind or ahead it may be in terms of materials and labor spent; and to tell, in addition, whether the work is ahead or behind in cost, and how the work actually done compares, unit for unit, with the estimates. After predicting the weekly labor expenditure, made up of the cost of all schedules to be under way in any week, these methods make it possible to tell definitely in terms of dollars and cents, and without elaborate pencil-sharpening or guesswork, whether the job is gaining or losing, and exactly which features of the work are responsible for the variation from the estimate. The system is described by Dan Patch in Engineering News-Record.

The writer will not enter into any discussion as to whether there is any advantage in having a prediction of the size of the weekly roll on construction work in advance of the actual expenditure. But it appears to him to be of importance to those financing the work to know not only how much money is to be spent but when, and of quite as much importance to the contractor to know not only how large gangs he must have but when he will need them.

The construction company for which the writer works has for some time plotted on a progress chart its schedule of dates for the operations to be undertaken on each of its important jobs, as an aid to the logical ordering and delivery of materials to the job and as a scheme for the job superintendent to follow in order to reach the ultimate date of delivery on time. In addition, however, the management desired a method of keeping in the central office a record of the job's effect on the schedule. As a result of this, the new method was devised.

The progress chart now has combined with it a "bogey score," or list of items of work with the estimated quantities and amounts of money allotted for their performance. The money allotted for each item is divided up throughout the time scheduled in weekly amounts, which are placed below the schedule line in the middle of the week space. At the right of the week space, below the line, is put the sum to date of these estimated weekly amounts. This, of course, must equal at the end of the line the amount allotted in the "bogey score." When all the money has been thus distributed, each column is added and the total weekly payroll for each determined. These, in turn, are summed to date,



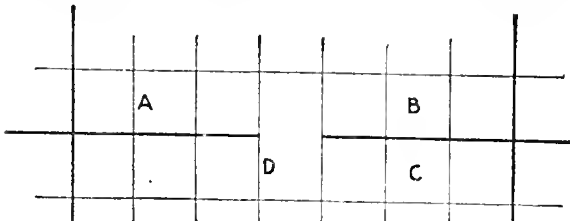
Figures comparing actual cost with estimated cost of actual work done and with estimated cost of work scheduled show whether money is being saved or lost on each item.

the total equaling the total of the "bogey score."

The prediction of the weekly roll and the total to date are plotted on a progress curve sheet, as shown, in fine lines, the horizontal lines representing the payroll and their connections making the figure resembling the cross-section of a mountain range. The form of this figure will vary according to the type of job and speed of construction. The curve of "total to date" is the typical sinusoid of most construction costs.

With the construction of the chart and curves understood, the methods of following the performance will be grasped readily. The cost of each item is kept by the field timekeepers against the mnemonic symbols set opposite each item in the "bogey score." These costs to date are entered each week in the left-hand side, above the line for each item. But the cost of most items is made up of a quantity of work done at a certain cost. This quantity of work, at the unit cost allowed in the "bogey," is set down in the right side of the week, above the line. The total weekly roll is entered at the foot of the column under the predicted roll, and this roll, less extras, underneath this.

Now, if any one item is considered the rectangle for any week which has passed, it will look as follows:



A—Actual cost of item to date.

B—What cost would be if done at the units allowed in "bogey score."

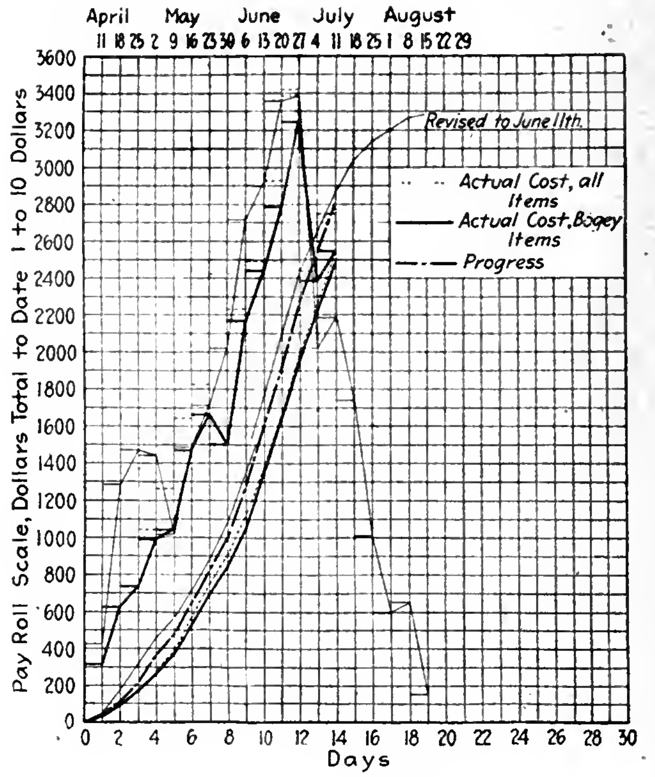
C—What cost would be if the quantity scheduled had been done at the units allowed in the "bogey score."

C—Predicted weekly expenditure on item.

Then if A is less than B, the job is saving money on the item; if A is greater than B, money is being lost. If B is greater than C, the job is pushing the item ahead of schedule; if B is less than C, the item is behind.

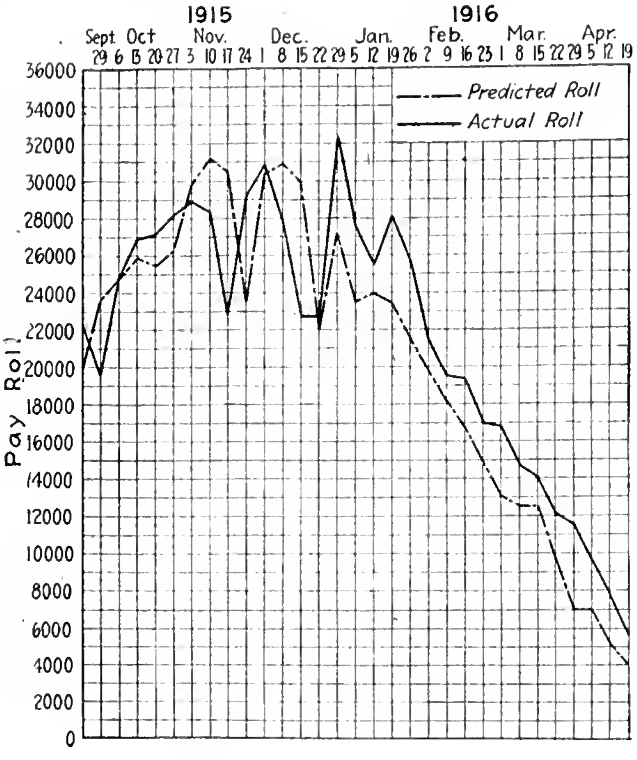
The blueprints which are posted on the central office board are not filled out each week so as to give these detail figures, but a graphic method is used to give the results.

If any item does not start on the date set, a red line is started above and continued until the item starts or is cancelled. The traveling superintendent is notified of the red line, and he either notifies the office that the



Curve of total payroll to date.

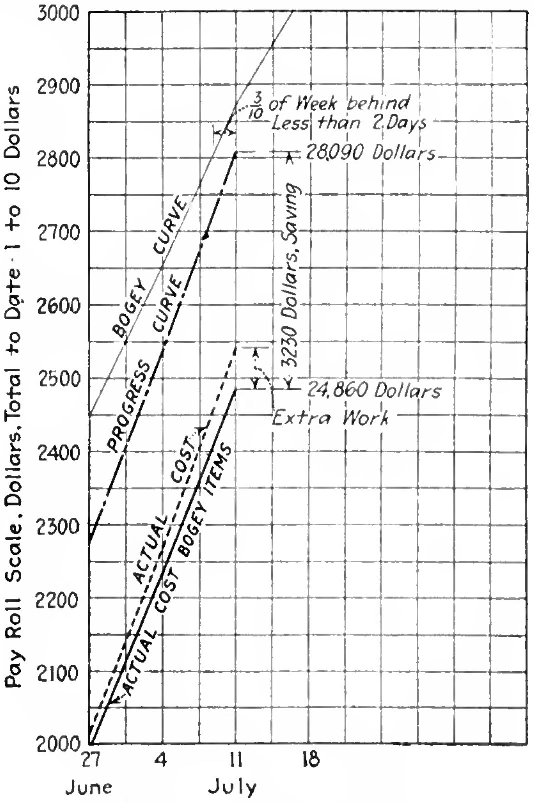
item has been found unnecessary, as is sometimes true of sheeting for footings, etc., in which case a white line is drawn underneath, or takes steps to get the item started. When the item starts, a yellow line is placed beneath and drawn up to the point where the money to date, under the line, is equal to the cost to date at "bogey" units—that is, where the value of C equals B. This graphically represents the proportion of the item done and at the completion of the item will just reach the end of the item line. As each week is entered, a white vertical difference line is drawn through the



Predicted and actual weekly payrolls.

date, so that it is more easily seen how the job stands. The bottom of the chart has the standing of the whole job plotted. These results are also plotted for the total job on the progress curves in the heavy black lines.

This description will give the reader an understanding of how the curves to which reference is made are



Graphic method of showing progress.

constructed. Now, it is to be noticed how closely the actual results follow the predictions—that is, how similar the heavy is to the light line form. This would indicate that for any given job a very close approximation to the labor demands and expenditures can be predicted to a considerable time ahead. By reference to the chart, the trade of the labor at any particular time during the job can be determined—that is, when masons will be demanded and how many, etc.

In case of large operations, covering groups of buildings, the superposing of these individual job curves, showing the predicted and actual weekly rolls, of which one of the diagrams for one of the company's large contracts is an example, will give a resultant curve of the total operations to be financed. Labor is an active liability, and has to be met with cash. Merely dividing the total estimated cost by the length of the job gives no idea of the peak load, which may be of importance. This financial prediction is an interesting, if not a valuable, byproduct of the plans developed for following the progress of the job.

It may be of further interest to note the graphic method of showing the progress on the progress curve sheet. To do this, consider the curves for the job for which the progress chart is shown. Enlarge the section near the terminal of the lines to date of July 11, and the diagram will indicate the conditions of the job. Should the progress line be on the opposite side of the "bogey" curve then the job would be ahead of schedule; if the curve of the actual cost of "bogey" items should be above the progress curve, there would be indicated an overrun in cost.

Construct a Highway of Solid Salt

A unique roadway of solid salt, forming a part of the Wendover highway in Tooele County, Utah, is projected by the Utah State Road Commission. Between Timpie and Wendover the line of the highway traverses a flat area, crossing at one point a salt bed about seven miles wide. For a considerable portion of the year this bed is covered with water which, while it thoroughly saturates the roadway, is never of sufficient depth to impede the progress of vehicles. When dry, the bed is found to make an admirable pavement, with salt two to three feet deep, hard and smooth, and with a tendency to cool the rubber tires of motor-driven vehicles.

The plans of the commission provide for the establishment of wooden bulkheads of 2 x 12 in. plank 16 ft. wide and made practically watertight. A pump installation, drawing its supply from lakes of heavy salt water, will pump continually into these trenches, replacing evaporation and leaks until the roadway is formed of crystallized salt to the desired depth. About 40 miles of pavement is to be built by this process, and the cost, as estimated, should not run over $1,500 per mile. If at any time before construction it becomes desirable to widen the roadway, this could be done without any material addition to the cost.

Durability of Metal Lathing

Although there is no question as to the durability of expanded metal lath, the experience recorded by a certain architect is both interesting and confirmatory. In removing some exterior stucco he found that the metal lath which was applied nine years ago was in exactly the same condition as it was the day it was put on, having taken on no rust whatever. The stucco applied was cement mortar as a scratch coat—enough to thoroughly imbed the metal lath. The second and third coats were of cement mortar, with a small proportion of lime added to act as a retarder, and no waterproofing of any description was used on the work.

Ethics of the Architectural Profession

Abstract of Paper Read at Royal Architectural Institute of Canada Outlines Professional Conduct — Architects Should be Associated

By W. A Langton

A RIGHT understanding of the principles that should regulate the behavior of those who practice a profession is involved in a right understanding of the nature of the profession. In considering that we shall, at the same time, be able to consider the snares that lie in wait for the inexperienced and the thoughtless; snares manufactured, for the most part, by members of the profession, who do not understand the nature of their calling, or by the very public for whose advantage it is that the restraints of professionalism should govern the practice of architecture.

A profession has two essential peculiarities; it acquires special knowledge so that those who want to obtain its results are obliged to put themselves in the hands of a trained practitioner; and the article which is for sale and purchase is the intangible, unassessable and unguaranteed measure of the practitioner's power to perform an important piece of work. There are, as it were, no goods upon the counter. This latter condition is, it is true, also the case in other callings in which the thing for sale is personal service only; but the element of importance is lacking.

From these two essentials then—that the architect alone has the talent and training required for his work, and that his possession of these requisites is always unproved for work not yet done—we may deduce the principles that should govern him in his relation to his art, to his clients, and to other members of his profession.

Serving the Clients

The first point, and the principal point, in the ethics of architectural practice is that the architect should be able to do the work he undertakes to do. He must fit himself to deserve the confidence that is placed in him. Most architects get the length of insisting that they be given the full confidence of their clients. They are always ready to exalt the architect. There are no doubt some who think that this institute is intended to exalt the architect, to take care of his interest. It is not. This institute and our provincial associations intended to exalt the art and practice of architecture, to create high ideals of both in the minds of architects and so help them to better performance. These bodies are, therefore, really intended to take care of the interests of the clients of architects. There is no room for any other aim, for the practice of architecture is the service of clients. The architect must not only have no other aim which contradicts this, but he may give himself up wholeheartedly to this aim with the certainty that in it will be fulfilled all legitimate ends of his calling, art, honour, profit and good will to men.

Fee Not a Consideration

It may be asked, in connection with this—is not the architect to think of his fee at all? In reply to this we must recognize that, though the carrying out of an architectural design is of so complicated a nature that the joy of performance can hardly obtain all through for the artist, as it does in simpler arts which are executed by the artist's own hand, yet it is creative work; and the result, in its development and attainment, are an end in themselves and enough to absorb the mind of a real artist, to the exclusion of thoughts of the reward. But the architect's mind, or the composite mind of a firm of architects, must include a grasp of the means of financing the expensive operation of producing good work. He must for that reason think of his fee. But the fact is that for nearly all kinds of services there is no occasion to think of it. The schedule of fees fixed by the associations are intended to make such thought unnecessary. They are arranged, so far as possible, to secure for all kinds of work a payment that will enable the architect to keep up the means of performing it properly.

If the provisions of the schedule prove to be insufficient, or an architect thinks he is entitled to more, he has a perfect right to fix a fee to suit his own ideas; and indeed he ought to do so. He cannot meet an insufficient fee by work to match. There is but one grade of professional work—the best; and it must be paid for. It must also be paid for by the client.

Exploitation Not Permitted

The latter condition opens up another point of proper practice. It is not conducive to the proper practice of architecture, that is to say, to the true service of the client, that the architect should receive pay from anyone but the client, or should find pecuniary profit in building for clients in any other way than by direct payment from the client. He may not, therefore, deal in building sites, in such a way that it is to his interest that a client's building should be placed on one site rather than on another. He may not be a party in the contract or have any interest in it. He may not receive payment of any kind from any one who is concerned in the erection of the client's building, except the client himself, and, therefore, for instance, if he has made a successful invention in building material or contrivance, he had better get rid of the patent right altogether rather than make his profit in royalties on its use. He must, in short, have payment for his work so arranged that he can give himself up to it, when it is once undertaken, without thought for anything but its perfection in the interest of his client.

How Far Can Client be Humored?

Here arises another question, which is often raised by architects, how far is the client to be humored in wishes which interfere with good design? This question deserves a paper to itself. The answer turns upon the question, what is good design? My own opinion is that, where the client's wishes have interfered with good design, the defect is to be referred to the designer. The problem set before the designer is the client's wishes. It is from these that he must make his design; not from his own preconceived notions embodying some architectural conception. We do not look for draughtsmen's designs from architects. Taste can take precedence of precedent. The true architect takes fire most when confronted by a problem. It is the reconciling of inconsistencies that gives life to his design. Why should we find the irregularities of old work, the freedom of good classic design, the imperfections in logic of the English Gothic so charming, and yet fear to have in our own work irregularities that have a reason and imperfections that make for comfort? It is seldom that faithful effort to combine good work with attention to the client's wishes will find that the two are really incompatible; but if it does, if the architect finds at length that he must suffer opposition, he will be able to back it with good reasons.

Service Always the Ideal in View

The architect must, however, be on his guard against falling in with the wishes of his client, when the latter wishes to do something that is not decent behavior towards a neighbor, or in the way of evading municipal regulations. It must be remembered that at the back of his mind the owner is relying upon his architect to keep him within limits in these matters. He feels out in consultation how far he may go in considering exclusively his own interest, and will not think well of an advisor who lets him go too far. It is the architect's duty, in the first place, to see if the object the client has in view can be obtained without encroaching on the rights of others, by further study of the plan or by original contrivance. If it is manifestly impossible to do otherwise than wrong, it becomes the architect's duty to point out to his client that in so carrying out his wishes he would be giving him bad service and that he must decline to do so.

Even at this pinch it must be seen that quarrelling with the client is not included. The architect must be reasonable or he is wrong. If the architect is reasonable he must be right; and he is most likely to meet with the respect which is his due and the deference to his opinion which the case demands. Where a client and his architect part in mutual anger, there is room for the architect to doubt the ethical correctness of his own conduct.

Competitions Do Not Produce Best Work

The question of taking part in competitions which exercised so much the minds of a past generation of the profession has been settled for practice by a compromise. No architect really believes that there is any real ground for the idea of the general public that the best possible design for a building is to be got by making a selection from a number of designs by different architects. One may say with certainty that the designs are not the best that can be made; for any of the same architects would produce better results, if they had an opportunity of studying the problem quietly in consultation with the clients. Nor is the selection that is made at all certain to be the best selection. But, because competitions offer such a chance of a short cut to pecuniary success, there are always architects to be found who will support them. The councils of the profession have, therefore, agreed to accept, as offering some chance to be productive of good work, those competitions in which the competitors are paid for their sketches, so that they can afford to put into them a proper amount of study.

Young Men as Builders' Designers

In connection with young men and their work, it is worth while to notice a question that has arisen with the advent of large commercial buildings and large building firms. The builders are said to seek the elimination of the architect, offering to be responsible for the design as well as the construction of the buildings. We know, as a matter of fact, that there is no such elimination in the case of the most important buildings of this kind; nor, in similar cases are the owner's interests likely to go unguarded for the want of an architect employed by himself; but there must be a good deal of commercial building on a large scale done in this way. The designers, who work for the builders, must have an architectural training. Who are they? There may be some doubt among architects as to the propriety of architects being thus associated with builders. Any architect in such practice as to be in the way of employment to carry out similar work on behalf of the owner is not likely to be sought as a builder's designer, and the situation of now running with the hare and now hunting with the hounds is not likely to arise. For young men, however, graduates of the architectural schools, this is quite suitable work. They supply well what the builder wants, and will gain invaluable experience for themselves. Hack-work has always been a wholesome exercise for genius in the arts, and there have been much lower walks in hack-work in the past than these modern monumental performances in commercial building.

Architects Should be Associated

In conclusion it is fitting to notice how important it is, in order to practice architecture with ethical correctness, that architects should be associated; not only to discuss and elucidate questions bearing upon such practice, but to give one another the support of companionship in sustaining a standard that it is hard to uphold alone. The honorable among the dishonorable is apt to suffer loss; and if we agree in approving of the honorable practice of our profession we had better agree in practising it thus together. This is the reason for professional associations, and it is also a reason why they should not be so wide open as to include practitioners who are unfit or unwilling to give good service to the public. Membership in our associations should be so obviously an advantage, not only from the professional standing it gives, but from the interest and value of the proceedings, that everyone who undertakes to practice architecture will find it important for him to seek membership and to devote himself to the kind of professional service that the associations exist to uphold. This refers more particularly to the voluntary association; and it is not at all certain that when there is full recognition of their necessity the effort required to make them of value will not make their influence in the production of good work in architecture greater than that of a statutory association, though less widely spread.

Asphalt Joints in Road Construction

One road engineer in charge of a large amount of public work made a most thorough analysis of the so-called asphalt joint materials used in concrete roads. He found some 99.3 per cent. pure bitumen, others 97.2 per cent., another 66 per cent., and so on. So far as the practical purposes of the work involved are concerned, however, the purity of the joint made little difference. In fact, a joint which is too nearly pure has in some cases been a nuisance in hot weather, as the bitumen strips would stick together so as to make them useless.

Error in Road Tractive Resistances

An error occurred in the publication of a table of road tractive resistances appended to a letter by A. C. D. Blanchard in the Contract Record of Oct. 10. The figures in the second and third columns should be interchanged. The corrected table is as follows:

Kind of pavement.	Resistance on level grade. In dry warm weather.	Resistance on level grade. In wet cool weather.	Additional resistance for each per cent. of grade. In dry warm weather.	Additional resistance for each per cent. of grade. In wet cool weather.
Brick	35.4	....	18.3	....
Bitulithic	42.5	35.4	19.5	17.1
Treated wood block	47.8	40.7	17.7	21.3
Cedar block	62.5	74	19.7	18.5
Asphalt	67.3	56.7	26.1	14.8

Building Statistics

THE trend of building work in Canada, as indicated by the building permits issued in the month of September, is still on the down grade. As may be noted from the following table, which shows the building permits issued in the 35 chief cities of the Dominion, the decrease, as compared with the same month in 1916, is 16.96 per cent., or close on $600,000. There is also a drop of over $476,000, or 14.34 per cent., from the figures reported for August. All the provinces, with the exception of Ontario and the two prairie provinces, Saskatchewan and Alberta, register a decrease as compared with September, 1916. The startling decrease shown in the British Columbia figures appears rather strange. This province, from all reports, is in a prosperous condition, and it is difficult to explain the discrepancy of the figures, except it may be that in both Vancouver and New Westminster there was very unusual activity in the building trade during this period last year. Another interesting point to note is that the city of Hamilton, Ont., is apparently enjoying a building boom, registering a higher figure than any other city in the Dominion and almost trebling her last year's record.

Estimated Cost of Building Work as Indicated by Building Permits Issued in Thirty-Five Cities

City	September, 1917	September, 1916	Septemper, 1917, compared with September, 1917 Increase (*) Decrease (†) Amount	Per cent..
Nova Scotia	**$ 189,943**	**$ 299,025**	**†$109,082**	**† 36.48**
Halifax	91,600	284,235	† 192,635	† 67.77
Sydney	98,343	14,790	* 83,553	*564.93
New Brunswick	**38,600**	**34,150**	*** 4,450**	*** 13.03**
Moncton	8,400	12,900	† 4,500	† 34.88
St. John	30,200	21,250	* 8,950	* 42.13
Quebec	**419,329**	**621,003**	**† 201,680**	**† 32.48**
Maisonneuve	23,500	1,800	* 21,700	*120.56
Montreal	250,958	205,456	* 45,502	* 22.15
Quebec	84,616	243,633	† 159,017	† 65.27
Sherbrooke	3,200	6,500	† 3,300	† 50.77
Three Rivers	21,005	144,070	† 123,065	† 85.42
Westmount	36,050	19,550	* 16,500	* 84.40
Ontario	**1,710,851**	**1,526,721**	*** 184,130**	*** 12.06**
Kitchener	7,900	21,865	† 13,965	† 63.87
Brantford	8,000	56,090	† 48,090	† 85.74
Fort William	10,500	192,600	† 92,100	† 89.76
Guelph	9,010	12,400	† 3,390	† 27.34
Hamilton	658,000	167,390	* 490,610	*293.09
Kingston	13,936	6,071	* 7,865	*129.55
Kitchener	7,900	21,865	† 13,965	† 63.87
London	59,395	39,710	* 19,685	* 49.57
Ottawa	97,050	135,100	† 38,050	† 28.16
Peterborough	980	16,145	† 15,165	† 93.93
Port Arthur	18,128	93,035	† 74,907	† 80.51
Stratford	37,933	15,963	* 21,970	*137.63
St. Catharines	49,653	54,110	† 4,457	† 8.24
St. Thomas	22,285	46,345	† 24,060	† 51.91
Toronto	650,271	643,272	* 6,999	* 1.09
Windsor	67,810	116,625	† 48,815	† 41.86
Manitoba	**143,660**	**237,548**	**† 88,888**	**† 37.42**
Brandon	53,860	5,698	* 48,162	*845.25
Winnipeg	94,800	231,850	† 137,050	† 59.11
Saskatchewan	**137,860**	**130,645**	*** 7,215**	*** 5.52**
Moose Jaw	10,845	100,200	† 98,355	† 90.07
Regina	22,700	9,500	* 13,200	*138.95
Saskatoon	104,315	11,945	92,370	*773.29
Alberta	**145,300**	**142,030**	*** 3,270**	*** 2.27**
Calgary	108,200	101,400	6,800	* 6.71
Edmonton	37,100	40,630	3,530	8.69
British Columbia	**53,490**	**433,760**	**380,270**	**† 87.67**
New Westminster	2,000	15,635	13,635	† 87.21
Vancouver	36,900	415,250	378,360	† 91.09
Victoria	14,500	2,775	11,725	* 42.52
Total (35 cities)	$2,844,033	$3,424,888	†$580,855	16.96

Long Term Bonds for Road Financing are Inadvisable

IN Circular No. 74, the United States Department of Agriculture issues figures regarding state highway mileage and expenditures during 1916. Comment is made on the abuses of the bond method of financing, long-term bonds being issued in payment for improvements which cannot possibly last one-half of the term of the indebtedness. "This practice should be discontinued at once," states the circular. No doubt some of the remarks might well be applied to many districts in Canada. The following is an abstract from the bulletin:—

Cash expenditures on the rural roads and bridges in the United States in 1916 amounted to $272,634,424. To this should be added the value of the statute and convict labor, which cannot be fixed with any great degree of accuracy, but probably amounted to not less than $15,000,000, thus making the grand total expenditure for the year $288,000,000. This total is made up of the actual expenditure for such items as labor materials, supervision, management, and administration directly connected with the construction, improvement, and up-keep of public roads and bridges. This, however, does not represent the total outlay by the States and communities because of their rural public roads. At present there are outstanding more than $400,000,000 of road and bridge bonds and long-term warrants, maturing at the rate of about $20,000,000 per year and requiring about an equal amount for the payment of interest charges.

Long-Term Bonds Poor Business

The full extent of this bond burden, however, is impossible of any exact determination. More than $40,000,000 of new road and bridge bonds are now being issued annually. Furthermore, general bonds are issued in many cases to cover actual or threatened deficits occasioned wholly or in part by the road and bridge expenditures. Outstanding road or bridge bonds or warrants often are taken up by general refunding bonds and the identity of the bonds as pertaining to road work thus lost. Such data as are available, however, serve forcefully to call attention to the abuses to which the bond method of financing often is being subjected. To issue bonds for the financing of road improvements frequently is both advisable and necessary. But this does not justify some of the present-day practice. Millions of dollars' worth of road bonds having a term of 30 years or more still are being issued every year, and one State has gone so far as to legalize and encourage the use of bonds having a term of 41 years for the financing of local road construction. This all too frequent practice of issuing long-term bonds in payment of improvements which cannot possibly last one-half of the term of the indebtedness can be defended neither on the grounds of sound public policy nor of good business. It should be discontinued at once.

From 1904 to 1915, inclusive, the annual increase in the expenditures on rural roads and bridges amounted to approximately 12 per cent. over each preceding year. The increase of 1916 over that of 1915, however, was only 2 per cent. This was due largely to the scarcity of labor and materials which caused an unusually large number of contracts to be carried over to this year.

Ottawa Engineers Visit Aylmer's Filtration Plant

On Saturday, Oct. 20, the Ottawa branch of the Canadian Society of Civil Engineers paid a visit to Aylmer, Que., and held their luncheon at the British Hotel in that town. The object of the trip was to afford the members an opportunity of looking over the town's new filtration plant, which they were permitted to do through the courtesy of the mayor and council. They left Ottawa on a special car provided by the Hull Electric Railway, and on arriving at Aylmer the first item on the program was the luncheon, after which a paper was presented on mechanical filtration. Following this the visit to the Aylmer plant added a very practical interest to the day's proceedings. This meeting was also of special importance on account of the presence of Mr. Fraser S. Keith, the new general secretary of the society, who paid his first official visit to the Ottawa branch on Friday and Saturday, Oct. 19 and 20. Mr. Keith also attended the luncheon at the British Hotel in Aylmer, when he addressed the members.

Getting and Keeping Labor a Difficult Problem

At the present time there is no problem which presents greater difficulty to the contractor than the handling of labor. It is hard to get and hard to keep. As the experience of others who have had to face the same obstacles generally contains something of a helpful nature, the following abstract from a committee report regarding the obtaining and retaining of track labor, presented at a recent convention of the Road Masters' and Maintenance of Way Association in the United States, will no doubt be of interest:

Obtaining and Retaining Track Laborers By the Railroads

On sections or where locations of labor headquarters are a fixture every effort possible should be made to encourage trackmen, either laborers or foremen, to own their own houses. A foreman should be given an idea of the permanency of his position by his superior and should, in turn, impart such knowledge to the men under him, and make them feel that they have an interest, not only in their work, but in their home town. The number of men should be the same in winter as in summer. There is no more pernicious custom than in keeping the men in a section gang guessing during the summer months who will be retained and who will be laid off when the first snow begins to fly.

Section foremen should be permitted to hire their own men, and when there are laborers who cannot or will not rent or live in their own houses, they should have a bunk-house provided by the company at a location convenient to the work; a plentiful supply of water, and where a certain amount of privacy can be obtained. This camp should be equipped with a cooking range and fixtures, and a cook of the same nationality as the men should be secured. He should be able to cook good, wholesome meals, have warm water for the men to wash in, and keep their sleeping quarters clean and comfortable. This arrangement will always attract good laborers.

When a foreman cannot secure his own laborers they should be furnished by the company's authorized labor agent, but the labor agent's connection with them should end there. The custom of a labor agent furnishing the victuals and wearing apparel of the men they provide for the railway companies should be discouraged, as charges are made and deductions taken from laborers' wages, when this system is in force, that the men do not know of and which causes no end of trouble at pay day.

Provide All Conveniences

Men for extra forces or floating gangs should be hired by the foreman of the gang when it is possible, but in event that he is unable to do so, men should be furnished by an accredited labor agent employed by the company and working on a salary, to preclude any possibility of charging men or parties of men commission for their jobs—his sole duty being to get men from their source and deliver them to the foreman at the post needed, and where there should be all the necessary conveniences, either boarding shanties or bunk cars. Those should be provided with double-deck steel bunks, good ventilation, wash basins, water-coolers, and other facilities—a dining-car or dining-room well ventilated and sanitary, and cooking car or compartments provided with all cooking utensils, and a place for storage of supplies.

If Italian labor is employed the above arrangement may not apply, as they prefer to do their own cooking; and in such cases only good sleeping quarters are needed, with plenty of water and other sanitary arrangements, and a place provided, in charge of a storekeeper, where they can secure the commissary articles that they use.

British Columbia has Good Roads Convention

A good roads convention was held in British Columbia recently, opening at Duncan on Oct. 9. Reeve W. A. McKenzie, of Penticton, president of the Good Roads League of British Columbia, presided. Among the interesting items on the program was an address by Premier Brewster on "The Government's Policy Relating to Road-Building." Other addresses were as follows: "The Benefits to Be Derived from Good Roads," by Mayor Todd, of Victoria; "Highway Construction in British Columbia," by F. L. Fellowes, city engineer of Vancouver; "What Tourist Traffic Will Do for British Columbia," by J. R. Davidson.

The Council of the Canadian Society of Civil Engineers are raising a fund to send Christmas presents of tobacco to the members of the society overseas.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Conveyor Tunnel Roofed with Waterproofed Concrete Without Distributing Service

A GRAIN conveyor tunnel 600 ft. long, in which working clearance was very limited, was recently roofed with waterproofed concrete in three weeks without interrupting service on the conveyor.

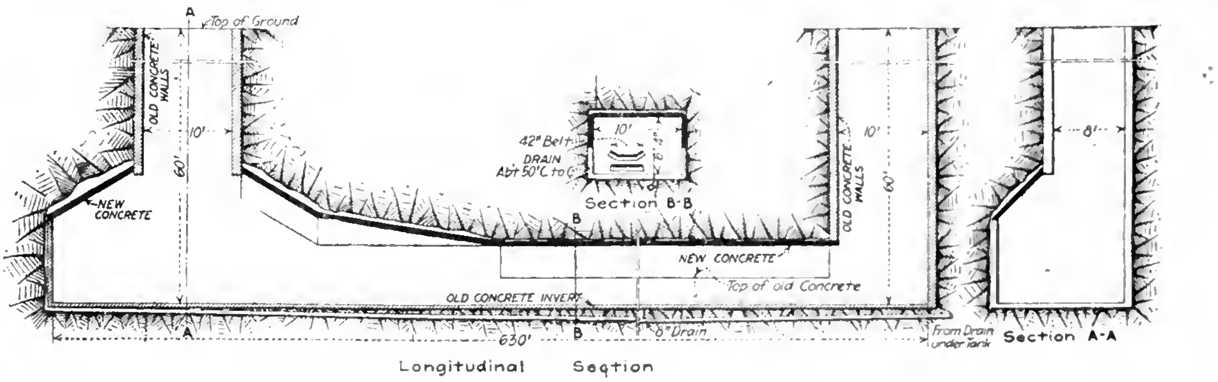
This interesting problem in waterproofing was encountered in connection with construction work at the plant of the Washburn-Crosby Company, in Minneapolis. Early in 1917 this company completed a large grain elevator on a site about 650 ft. from its plant. The elevator was connected with the mills by a tunnel 10 ft. wide by 7 ft. high, located 60 ft. below ground and running through sandstone and shale strata. A 42 in. belt conveyed the grain to the mills. At the time of driving the tunnel an 8 in. sewer was laid under it and the invert and sides to a height of about 3 ft. were lined with 5 in. of concrete. Three-inch pipes were placed in the concrete from the sewer to the top of the sidewalks, about 50 ft. c. to c. As the tunnel was then perfectly dry, it was decided to leave the upper part unlined.

After grain had been run through it for about a month, however, several leaks developed in the roof, especially at the entrance shaft. They grew worse day by day, making it necessary to place sheet-iron watersheds over the belt at numerous points. When the leakage finally became so bad that at the entrance for a distance of 40 ft. it resembled a light, steady rainfall, it was decided to line and waterproof the entire tunnel.

After several methods of doing the work were considered and discarded as impracticable, it was decided to line the tunnel with about 6 in. of concrete, using a flat roof slab with ⅜ in. bars, 6 in. c. to c., and to continue the 3 in. drain pipes up to the top of the roof slab, leaving a space between the top of the slab and the rock clear across the tunnel wherever necessary for drainage.

Working conditions were about as bad as could be imagined. The available space in the entrance shaft for taking down material had an area of 4 ft. 6 in. by 2 ft. 6 in. The rest of the shaft was taken up by the elevator legs. The conveying of grain through the tunnel could not be interrupted or delayed during the work, and the passageway along the belt had to be kept as free from obstructions as possible. The clear headroom could not be decreased to less than 6 ft. 4 in.

The roof slab at the entrance shaft was centered up first. On account of the steep slope it was necessary to build two sets of centering, one above and one below the slab, the top one being left in place. The concrete was mixed outside and chuted into the tunnel through a 10 in. pipe, with a swivel joint 5 ft. above the bottom of the shaft walls. On each side of the old concrete shaft a hole was cut through the old wall and the concrete for the roof slab was spouted into place for a distance of about 10 ft. from the shaft. The concrete for the remainder of the tunnel was spouted into a box, put into wheelbarrows, and wheeled to the point of deposit.



Roof of tunnel lined in three weeks under bad working conditions

The work was carried on with a day and a night crew, working ten hours each. Each crew was divided into three gangs, the first putting up centering, the second concreting the side walls, and the third concreting the roof slab. The boards for the roof-slab centering, which ran at right angles to the tunnel, were placed four or five at a time, the reinforcing was laid, and the concrete thrown in with short-handled shovels. It was then smoothed down and floated and another section of four or five boards started. It was surprising to see the skill with which the men handled this work after a short period. The belt was protected during the work with a section of sheet iron, which was moved with the concreting.

A 1:2:4 concrete was used, with Trus-Con concentrated waterproofing, mixed in the proportion of 1 gallon of waterproofing to 24 gallons of water. The whole job, including the difficult work at the shaft, was completed in a little more than three weeks. The grain-moving had not been interfered with, and not a single leak showed after the forms were removed.

Pressure Filters of Rapid Sand Give Good Service at Low Cost

AT the recent convention of the New England Waterworks Association a paper was presented by George A. Johnson, in which he discussed the pressure type of mechanical or rapid sand filter, the extent of its employment, and the conditions to which it is particularly adapted. Abstracts from this paper follow:

Pressure Type Rapid Water Filters Still Have a Place

Pressure filters of the rapid sand type are now operating on municipal supplies in the United States in 140 places, with a present total population estimated at 1,946,000. The combined capacity of these 140 plants is 257,200,000 gallons daily. The individual plants range in size from 100,000 gallons daily up to the 21,000,000-gallon plant at Atlanta, Ga. Pressure filter plants constitute 20.5 per cent. of the total number of municipal rapid sand filter plants in the United States, 10.8 per cent. of the total filtering capacity, and 10.6 per cent. of the total population served.

The pressure filter was, and still largely is, of stereotyped design. The model pressure filter of to-day can be fitted with rate controllers and devices for accurately proportioning the dose of coagulant. Everything that can advantageously be built into a gravity filter system is equally applicable in a pressure filter system.

Pressure Filters Economical

The pressure filter is particularly adapted to water problems where double pumping would be an important item of expense, since with this type of filter one pumping may be avoided. Along the general line of filter-operating economy it is significant that of all the pressure filter plants operating on municipal supplies in this country more than one-third are owned by private companies. Such companies certainly operate their properties as economically as possible, the first thought of the business man naturally being to furnish satisfactory service at the lowest possible cost. Such operators of pressure filter plants evidently are able to secure good service for less money than would be possible with gravity filters.

Since water sterilization gained an accredited standing the requirements of water filters, per se, have been altered materially. With the realization that cheap and efficient means had been found whereby dangerous bacteria in water could be readily killed, the necessity of relying upon the filter for high bacterial efficiency passed away. The filter is still needed to remove color and turbidity, but sterilization of the physically satisfactory water may be relied upon to insure satisfactory bacterial results.

New Book

The Concrete House and Its Construction—by Morris M. Sloan; 224 pages, illustrated, 6 in. x 9 in.; cloth bound. Treats of the design, construction, and architectural features of concrete houses. The following are the chapter headings: The advantages of concrete for house construction; architectural design and treatment of concrete houses; details of construction; operations in the field; calculations for determining the strength and design of reinforced concrete in house construction; calculating the bending moments for reinforced concrete beams and slabs and the determination of size and reinforcement; tables for designing reinforced concrete and their use; concrete block houses.

Mainly Constructional

East and West—From Coast to Coast

Building permits amounting to over $32,000 were issued in London, Ont., during the first week of October.

The City Council of Hamilton, Ont., have decided to purchase new steam equipment for the Beach pumping station, at an estimated cost of $159,000.

The Coughlan shipyards at Vancouver, B.C., are closed down on account of a general strike of the employees. The men demand higher wages.

It has been decided to erect the garbage incinerator in Sarnia, Ont., on the Confederation Street site, adjacent to the Imperial Oil Company's plant.

The Toronto Board of Harbor Commissioners has applied for right to reduce to 82 ft. the 150 ft. roadway laid out by the city east of Cherry Street.

It is probable that Niagara Camp, at Niagara-on-the-Lake, will be continued all winter. If this plan is followed, huts will be built to house the men.

Residents in the district are agitating for a wagon road between New Denver, B.C., and Sandon. A petition is being made to the government for financial assistance.

Mr. T. D. Mylrea recently resigned his position as engineer of tests of the city architect's department, Toronto, to become chief engineer of the Trussed Concrete Steel Company, Toronto.

The Finance Committee of the Toronto Board of Education request the City Council to put the estimates of the board for buildings and school sites to the vote of the people in January. The amount involved is $642,000.

Plans prepared by John A. Baird, city engineer of Sarnia, Ont., for the building of the proposed lake shore road have been forwarded to the Lieutenant-Governor for approval. If this is obtained, work will start at an early date.

Plans are under way for a celebration of the completion of the Toronto-Hamilton highway by the cities of Toronto and Hamilton, the Ontario Motor League, and the boards of trade. The officials feel confident that the new road will be open for traffic on November 16.

The expenditure, up till October, on the superstructure of the Provencher bridge, of which the cost is being jointly borne by the municipalities of Winnipeg and St. Boniface—one-third by the former and two-thirds by the latter—is $71,500. The total cost of the structure is estimated at $500,000. The Dominion Bridge Company are carrying out the work.

The big dry-dock at Quebec City on the St. Lawrence is now nearly completed. The boilers and machinery have been tested, the new gates are in position, and the coffer-dam, or false gate, blown up. Within a few weeks it is hoped to fill the dock for the first time, but as the approach has not been thoroughly sounded, it is not expected that any ship will enter the dock this year.

The Montreal Board of Control recently passed a resolution, subject to the approval of the law department, providing that when it is proposed to erect or repair a building the plans and specifications, or, where there are no plans and specifications, the application for a building permit containing a description of the work, must pass from the hands of the building inspector's department to the board of health, for the approval of the board's sanitary engineer.

The Victoria Machinery Depot has the contract for the construction of twelve boilers of the Howden water-tube type for installation in the wooden hulls now being built on the Pacific Coast for the Imperial Munitions Board. It appears that these are the first contracts placed on Vancouver Island for boilers. Since there are 27 ships being built for the Imperial Munitions Board, which will require 54 boilers, it is possible further orders will be placed.

The firm of E. J. McQueen & Co., of Fort William, Ont., has been awarded the contract for the erection of a reinforced concrete elevator for Henry Ford & Son, of Detroit, Mich., to be erected on the Ford country estate at Dearborn, Mich. It is to be completed before Jan. 1, 1918. Bids and plans were called for on a competitive basis, and the plans prepared by the McQueen company were considered the most satisfactory.

The Civic Works Committee of Toronto recently decided, subject to the approval of the city treasurer, to proceed with the extension of Crawford and Shaw streets and the filling in of Sully Crescent. The work was originally estimated to cost $131,388, and it was stated that a saving of $40,000 could be made by continuing the filling, as it would obviate the rebuilding of Shaw Street bridge. Street Commissi er Wilson was directed to deposit as much clean ashes as possible on the dump to hasten the filling.

City Engineer Grey of Hamilton, Ont., is preparing a statement showing the cost of maintaining water pipes under the railway tracks in various parts of the city and a report on the question of road maintenance between the main lines of tracks where they cross city streets. He takes the position that the city should not be put to the expense of repairing frequent breaks under the main lines and the switches over which heavy trains pass and jar the pipe joints, and recommends that the city place the matter before the railway board.

William Joyce, business secretary of the Bridge and Structural Iron Workers' International Union, has received an offer from the United States Government to employ every man of the 164 members of the Toronto union. The men are needed to go to France to build tanks, and will be paid the union rates of wages, given free passage overseas, and be boarded over there at 60 cents a day. Mr. Joyce stated that many of the men had expressed a willingness to go. They will not be asked to render any military service, but merely to work as mechanics.

Seventy representatives from the centres of population in British Columbia, including mayors, aldermen, development men, etc., recently met at Duncan, when they adopted a constitution for a good roads league. A resolution was also passed urging that the government proceed with the construction of a road across the province with the utmost expedition and endeavor to obtain financial assistance from the Federal Government. The convention unanimously decided to change the road rules in British Columbia to make them conform with the rules elsewhere.

On Oct. 4 a dynamite outrage was perpetrated at Fernie, B.C., when a charge exploded beneath a culvert through which it runs, wrecked the Darcy Creek water main, which is the city's main supply line. A fire call was rung in shortly afterwards, but the fire brigade had no pressure to fight the flames. The Coal Creek auxiliary water supply was turned on and a slight pressure was obtained, which was used to prevent the spread of the fire. A large force of men were set to work on the water main to repair the damage. In the meantime the water supply was limited to one hour per day.

United States and Canadian engineers recently met at the Hume, in British Columbia, to discuss the Kootenay Valley reclamation scheme and what data should be collected before any practical steps are taken toward carrying out the proposed drainage plan. S. H. McCrory, of Washington, represented the United States Federal Government. Other engineers present were: William Young, British Columbia controller of water rights; J. P. Forde, federal district engineer; J. G. Swan, head of the federal hydrometric service in British Columbia; W. J. E. Biker, provincial hydrographic engineer. Opinion expressed at the conference was favorable to the project.

A statement issued by the deputy city engineer of Toronto shows that since the town of North Toronto was incorporated with the city the total expenditure on public works alone in this section has been $1,350,562. The figures making up the total include capital and maintenance expenditure, and are as follows: Sewers, $132,414.92; roadways, $78,044.34; railways and bridges, $19,383.46; waterworks, $497,877.87, making a total of $747,720.53. To this is added $975.07 for labor account and $621,866.97 for local improvements. To complete the cost of annexation a statement from the Board of Education for the schools built and kept up, and also fire halls, would be necessary.

The Union Bank of Canada is erecting a new building on Scarth Street, Regina, at a cost of over $100,000, including fittings. The structure is to be of brick and stone. Carter-Halls-Aldinger Company, of Winnipeg, have the general contract and the work is to be completed by the end of the year. In addition the Union Bank is proceeding at the present time with the erection of six smaller offices in the same province—at Bruno, Gravelbourg, Macklin, Pennant, Perdue and Shaunavon. These offices will cost from six to eight thousand dollars each. In Alberta, the bank is also erecting two buildings, at Bow Island and Grand Prairie, and in Manitoba, at Crystal City and Killarney.

Among matters discussed at the annual meeting of the International Joint Commission in Ottawa recently was the application of the International Lumber Company for approval of their plans for booms and sorting gaps in the Rainy River at International Falls. The commission approved the project, stipulating, however, that in the event of booms or other similar structures being found necessary on the Canadian side of the river, opposite the booms of the International Lumber Company, the company should be required to remove their booms south of the boundary to such a distance as the commission might think necessary. Another question under consideration was that of the measurement and apportionment for irrigation purposes of the St. Mary and Milk Rivers, in Montana, Alberta, and Saskatchewan. Another meeting is to be held in New York on Nov. 12 to further discuss this matter, and also the commission's final report regarding the pollution of boundary waters investigation.

Personal

Lieut. W. H. R. Gould, B.A.Sc., of the Royal Naval Air Service, is reported missing. Lieut. Gould was on the staff of the Contract Record up to a short time previous to his enlistment. His home is at Uxbridge, Ont. He went overseas early this year, and has been missing since Sept. 26.

Obituary

Mr. Thomas E. Crowell, a well-known contractor, of Vernon, B.C., accidentally shot himself recently. The wound proved so serious that he succumbed a few days later in the Vernon hospital.

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Principal Contents

Necessity of Conserving Opportunities of Technical Practice

FOR many years efforts have been directed toward a betterment of the status of the technical professions in Ontario. The practitioners of these professions, especially those of architecture, have felt very keenly the need of improved conditions that they might develop the best that is in them for the benefit of the province. The need of some form of regulation that will apply to all branches of technology has long been felt. With the growing practice, however, of employing alien practitioners the need has become all the more urgent. Very recently, on behalf of the Ontario Association of Architects, the Canadian Manufacturers' Association and the Canadian Society of Civil Engineers, some effective reforms have been sought, and even ten years ago the fight waxed strong for remedial measures in the architectural profession. At that time licensing legislation to control the practice of the profession was dropped in favor of the promotion of education through a course in architecture in a recognized university.

An effective educational system is, indeed, the crux of the situation. If the Province of Ontario requires men with a knowledge of technology to handle its problems it must needs provide the means by which such training is obtained. Yet, although the province admits its responsibility in this matter, it has failed through its Department of Education to make this educational training in technology effective in increasing the standard of the professions. This is evidenced by the increasing number of important buildings—even governmental ones—being designed by alien architects and engineers and carried out by alien contractors, a practice which has deprived architects and engineers, trained in this province, of the opportunities that are open to them.

* * *

The Department of Education, as stated, is largely at fault in not taking advantage of the opportunities that are presented to it. The province, in establishing and supporting its institutions of technology, recognizes the necessity of providing training in this field of endeavor. And yet a very large proportion of the gradutes of these courses seek emolument after graduation outside of the province and outside of the country. Since the students' fees cover only about one-third of the cost of tuition, the other two-thirds being borne by the government, it is evident that, even from a monetary or economic point of view, the Department of Education is at fault. It is providing two-thirds of the cost of tuition that the student, after his course of training, may leave the province entirely to seek employment where opportunities are not withheld from him. In so doing, the Province of Ontario is spending thousands to train engineers and architects for alien countries, simply because the opportunities presented in the province are not retained for their benefit, so that they must seek practice in places where their worth is recognized. In other words, the manhood of the province is being developed for the benefit of aliens instead of for its own benefit—a breach of economic principle.

* * *

Although the department is thus failing economically, it is further missing the mark in not making its training effective by conserving the opportunities of technical practice for the resident practitioner of such technical work. Under present conditions the opportunities of the province are freely open to whosoever cares to partake of them, with the result that the cream of the province's work is not offered to its own architects and engineers. To conserve the opportunities of the province for those graduates in technology whom the province trains calls for legislative measures enabling the Department of Education to register resident practitioners. Such legislation would prove effective in retaining the men with technical training within the province to perform the work that would be conserved for their benefit. The opportunities of Ontario are sufficient to give employment to all of the technical graduates that can be turned out by our educational facilities What is needed is a measure to prevent these being exploited by aliens and also to prevent the technical educational advantages of the province being exploited in other communities.

Aim to Keep Pre-war Attendance in Engineering Classes

IN the address recently delivered by Sir Robert Falconer, President of the University of Toronto, before the Electric Club of Toronto, figures were given of the relative number of students to be found in the various faculties to-day and before the war. In the engineering course it was, roughly, one in six. In the other faculties perhaps a little bit better. The medical faculty was suffering with the others, and particular stress was laid by Sir Robert on the absolute necessity of maintaining this department at somewhere near its normal capacity that the requisite number of trained men may be available for carrying on the work of this profession, both during and after the war.

There is no sane Canadian citizen who does not give his unqualified assent to this appeal, especially as it was pointed out that approximately 75 per cent. of the students at present enrolled are medically unfit for active military service, and the large majority of the balance are under age as defined by the new Military Service Act. Indeed, when one considers the matter in this light, it is difficult to see why the number of students entering the various faculties is not much greater, since in all the faculties a big proportion will be under twenty years of age. One explanation, and probably the chief one, lies in the fact that the indiscriminate method of military selection that has prevailed in the past has taken a very large number of boys who would have served their country much better for two or three years at one or other of our universities. No doubt, also, the feeling that their course at the university would be interrupted has prevented many from starting in at all.

That conscription will remedy this evil to a considerable extent is something for which the nation has reason to be thankful. Even if a student does not finish his course, he has made some progress towards this goal, and, this being so, he is very much more likely, after the war, to take up the thread of his life where he left off than if he had never made a start.

That Sir Robert emphasized the need of the medical profession only and omitted to place the engineering faculty in the same category was doubtless merely that he spoke of that one faculty as typical of the general need for greater conservation of our mental resources, for, invaluable as the services of the medical units have been in this war, they can scarcely be given priority to the "engineer." Indeed, is it not repeated daily that this is a war of engineers? Is it not, then, of paramount importance that the supply of our technical men should also be undiminished.

If it is necessary to segregate, for military purposes, the medical doctors, for the special work for which they have fitted themselves (and no one doubts that it is), is it not equally important that the special training of our engineers should be given the fullest consideration in allotting them their part in this titanic struggle? And, further, if it is necessary that every effort should be made to maintain, as regards numbers, the pre-war standards of our medical schools (and no one doubts that it is), is it not equally important that the attendance at engineering classes should not be allowed to dwindle? Depleted ranks in the engineering profession would be a calamity, second only to depleted ranks in the French trenches.

President Falconer is surely right when he says that pressure—government pressure, if necessary—should be brought to bear on the situation, that the ranks of the medical profession in Canada should not be depleted. The same is true in no less degree of the engineering profession. Somebody should see to it that the number of young men entering these faculties is as nearly as may be up to pre-war standards. In some way we should ensure that the technical resources of our country are sufficient to "carry on," both now and in the days of peace to come. It is a duty, as we see it, every engineer owes his country that his voice and influence be exerted unceasingly to this end.

Concrete Floor Tested to Destruction

REMOVAL of a reinforced-concrete eight-storey warehouse building to clear the site for the new Union Station at Chicago, has been made an opportunity for testing one of the floors to destruction. The building is about 107 x 120 ft., with flat-slab floors. Four adjacent panels on the sixth floor were selected for test by loading with pig iron.

The panels are 19 ft. 4½ in. by 17 ft. 5½ in. centre to centre of columns. Each panel has four-way reinforcement (rectangular and diagonal), with 15 high-carbon steel bars ⅝-in. in diameter in each reinforcing band. These bands are 7 ft. wide. The slab is 8½ inches thick, made of gravel concrete, 1:2:4. The columns are octagonal. Those of the fifth floor are 24 inches in short diameter, with 21-inch core; those of the sixth floor are 21 inches in diameter, with 18-inch core. Their caps are 4 ft. 6 ins. in diameter at the top. Each column has eight 1½-in. round rods, wrapped with ⅜-in. wire in a spiral of 2½-inch pitch. The floor was designed for a live load of 250 lbs. per square foot.

The test loading consisted of pig iron, stacked in four piles on each of the four panels. It was applied in increments of about 200 lbs. per sq. ft. until a total of 910 lbs. per sq. ft. was reached. The first load was applied August 16 and the last August 28. Readings of deflections of concrete and steel were taken for each increment of loading.

The maximum deflection was 1.1 in. The approximate stresses at the maximum load were as follows: At column (Col. 22) 31,000 lbs. in direct rods and 52,000 lbs. in diagonal rods. At centre of panel, 23,800 lbs. in direct rods and 18,400 lbs. in diagonal rods. Deformation in the concrete around Col. 22 indicated by flaking of concrete that at certain gauge lines the ultimate strength of the concrete had been reached. These figures are the result of preliminary computations and may be changed when the computations are completed.

Referring to the high cost of labor and builders' supplies, a well-known Montreal architect states that he is advising clients to postpone building unless for urgent needs. "My reason," he said, "is that building is costing approximately 100 per cent. more, as compared with pre-war prices. Under this condition it is impossible for clients to obtain an adequate return on their investments. A very strong demand for houses exists, but with the present cost of construction, there is no inducement for people to build. It may be that after the war prices will drop; that remains to be seen, for it is impossible to foresee what will happen."

Completion of Last Section of the Toronto-Hamilton Concrete Highway

Last Five Miles at Entrance to Toronto the Most Important Part of Road—Difficult Construction—Designs of Concrete Arch Bridges

By H. S. Van Scoyoc*

AT the close of the construction season in 1916 the Toronto and Hamilton Highway was opened to traffic from the westerly limit of York County at the Etobicoke Creek to its western extremity at the city line of Hamilton. There remained uncompleted only about five and one-quarter miles out of a total distance between the two cities of approximately thirty-six miles. This portion in York County is in many respects more important than any other stretch of equal length. Instead of farm lands it traverses suburban property, much of it already built upon. In addition more than half of the total extent is within the boundaries of the village of New Toronto and the town of Mimico. Its construction had been delayed not only on account of disagreements with the bodies previously responsible for this portion of the highway, but also because of the work incident to the installation of both sewers and water works in Mimico and New Toronto.

Greater Width Necessary

It was felt by the Toronto and Hamilton Highway Commission that on account of the amount of local traffic in this district the roadway should be of greater width than the remainder of the highway. This point of view was upheld by the Ontario Railway & Municipal Board, who ordered a roadway twenty-four feet in width easterly from the western limit of O'Connor Road, which is the first north and south highway east of the Etobicoke Creek. The Commission in placing their estimates before the Board had suggested the desirability of varying not only the width, but the specifications as well, so that boulevards, kerbs, storm sewers and catch basins would be constructed rather than the deep open ditches of the rural sections. This was held to be optional work, however, the decision for or against it resting with the local municipalities affected. Mimico and New Toronto without delay requested the additional work but no authorization could be secured for the remaining sections.

Open Ditches Undesirable

The open ditches seemed especially undesirable from the easterly boundary of Mimico to the westerly limit of Toronto, for the original highway, including the portion occupied by the tracks of the Toronto and York Radial Railway, was nowhere sixty-six feet in width, and in some stretches was as narrow as thirty-eight feet. Land expropriation was unavoidable, but after acquiring land at a high cost it was to be used for the construction of open ditches and the permanent pavement so placed that it would have had to be torn up when the roadway was widened to take care of future needs. Many meetings were held but no agreement could be reached with the ratepayers directly affected until September 13th, 1917. Subsequent to that date land had to be expropriated, and three pole lines and the tracks of the Toronto & York Radial Railway moved before the pavement could be laid. Within less than six weeks after that date all of the pavement had been laid in the section mentioned.

Stone Embargo Delayed Work

In Mimico and New Toronto the trenches for sewers and water lines, in conjunction with the rains which continued almost daily until July 19th, left the heavy clay roadbed in such a condition that progress was almost impossible. (Fig. 1). In addition the need for cars in the coal trade prevented any shipments of stone for three weeks when the weather was at its

*Chief Engineer, Toronto-Hamilton Highway Commission.

Fig. 1—What the road east of Long Branch looked like last spring.

Fig. 2—The same section of road after the highway commission had done its work.

best for the laying of concrete. Notwithstanding all of these delays almost seventy-one thousand square yards of concrete have been laid since July 18th. In York County three standard cross sections have been used, as shown in Figs. Nos. 8, 9 and 10.

Probably the most interesting features of this year's work from a construction point of view, were the tearing up and removal of two miles of dollarway pavement, and the handling of more than twenty thousand cubic yards of excavation in connection with improvements in alignment and grade near the Etobicoke Creek (Fig. 3). There have also been some noteworthy improvements in alignment in the section be-between Mimico and the city of Toronto.

Steam Shovel Removes Old Concrete

The removal of the concrete sub-base of the Dollarway pavement was accomplished by means of a steam shovel, one of the Thew type with bucket of one-third yard capacity being used. This is perhaps the first time that a shovel has been employed for tearing up the concrete sub-base of a roadway, though it

Fig. 3—West of the Etobicoke Creek, a maximum grade of 6 per cent. has been reduced to 1 per cent.

has been used for similar work beneath a track allowance. Its operation was quite successful. Rapid progress was made, averaging 400 to 425 feet per day, and on one occasion at least reaching as much as 600 feet. The shovel gang consisted of six men with ten teams to haul the material away. The concrete broke up readily in pieces varying from one-quarter square foot to a square yard.

The tearing up of this pavement was occasioned by the fact that, while the Dollarway road carried very heavy traffic, it was not suitable for repair, while its alignment, width and the concrete mix used were not such that it could properly be included as a section of the Toronto-Hamilton Highway. This old roadway stretched from the Humber River to Church Street, Mimico, a distance of a little more than two miles. It was 14 to 15 ft. wide, built of a 1:2:4 mix concrete in one course, with a surface treatment of tar. As the commission desired to lay a 24-foot pavement at the Toronto end of the roadway, it was decided to tear the old road up, and the contract for this work was let to Francheschini & Company, excavating and grading contractors, of Toronto, for 68c a foot. This price included 3,000 feet of free haul. Part of the broken concrete was deposited as fill for the approaches to the new Mimico bridge, and the

Fig. 4—A reverse curve and a high bank made this a dangerous spot.

remainder was used to repair some of the streets in that town.

Four Concrete Bridges

The pavement of the roadway between Toronto and Hamilton is now completed with the exception of the larger bridges and the bridge approaches. Plans are being prepared for bridges at Mimico Creek (Fig. 6), and at Etobicoke, Port Credit and Bronte (Fig. 7). Construction will be begun just as early in the spring as weather conditions will permit. A high level structure at Oakville and a satisfactory entrance into Hamilton will scarcely be undertaken before the end of the war.

Fig. 5—The commission reduced the bank and made a simple curve with clear vision.

These bridges, designed by Messrs. L. G. Mouchel & Partners, Excelsior Life Building, Toronto (Hennebique system of ferro-concrete construction), are all calculated to carry Class "C" loading, as specified in General Specifications for Concrete Highway Bridges, Ontario. Fig. 6 shows the bridge at Mimico Creek. The bridge is an arch bridge, the arch being fixed in solid concrete abutments, which are carried down to

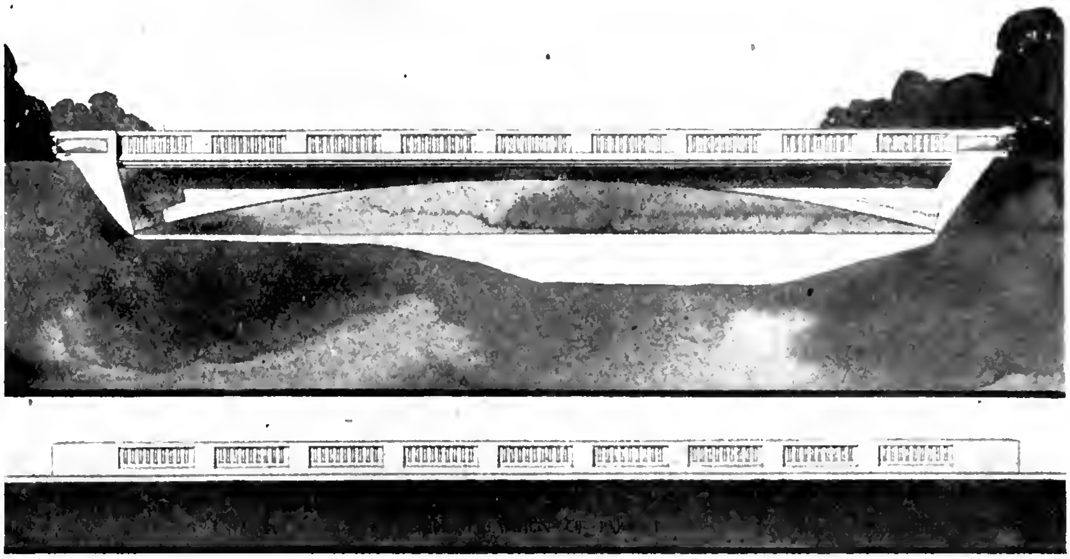

Fig. 6—Sketch of bridge over Mimico Creek. Low clearances govern designs of bridges on Toronto-Hamilton highway.

rock. This was deemed necessary owing to the extreme flatness of the arch, which naturally gives a very heavy thrust.

The clear width of the roadway is 26 ft., and the two sidewalks are 6 ft. wide; these, together with the reinforced concrete parapets, are carried by a slab cantilevered out from the spandril walls, retaining sand-fill, upon which the concrete roadway is laid.

The soffit of the arch is shaped as a parabola of the second degree, with a rise of 1:16.5, while the rise of the centre line of the arch is only 1:17.5, being, to our knowledge, the flattest arch constructed in this country for such heavy traffic. The clear opening of the bridge is 97 ft.

As the abutments for the existing bridge over Etobicoke River are in excellent condition, a structure where use could be made of these abutments was adopted—i.e., no thrust would be tolerated. Fig. 7 shows the bridge to be erected here. The thrust from the overhead arch ribs is taken up by a tie, which, together with the bridge floor, is suspended from the arches. The floor slab is carried by a system of longitudinal and cross beams, the latter being cantilevered out to take the two six feet wide sidewalks. As was the case with the Mimico Creek bridge, the parapets are constructed in reinforced concrete.

The arch ribs are shaped to ordinary parabolas, with a rise of approximately 1:5. They are braced to-

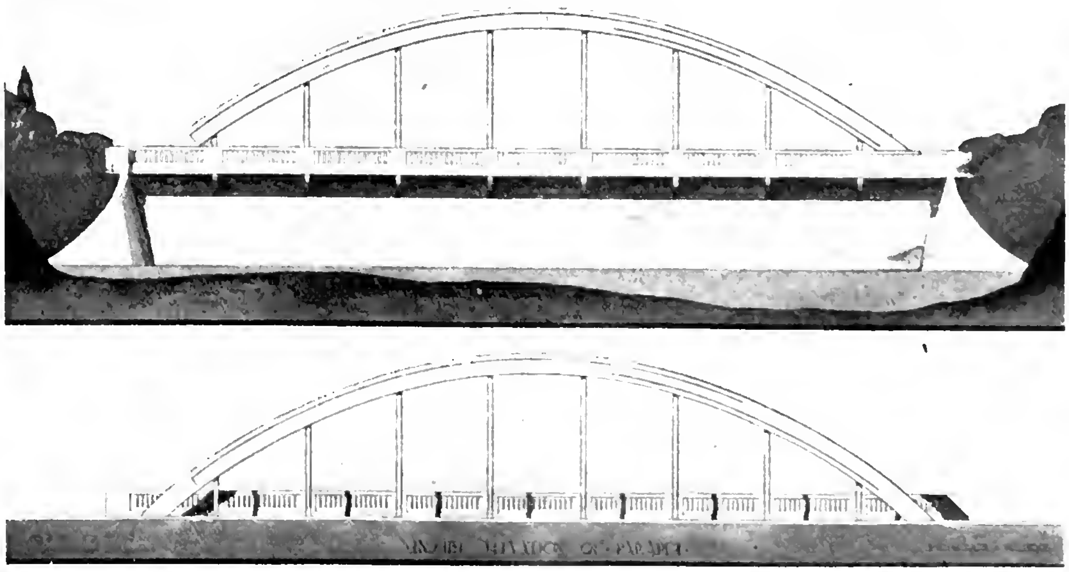

Fig 7 -Three bridges of this type will be erected.

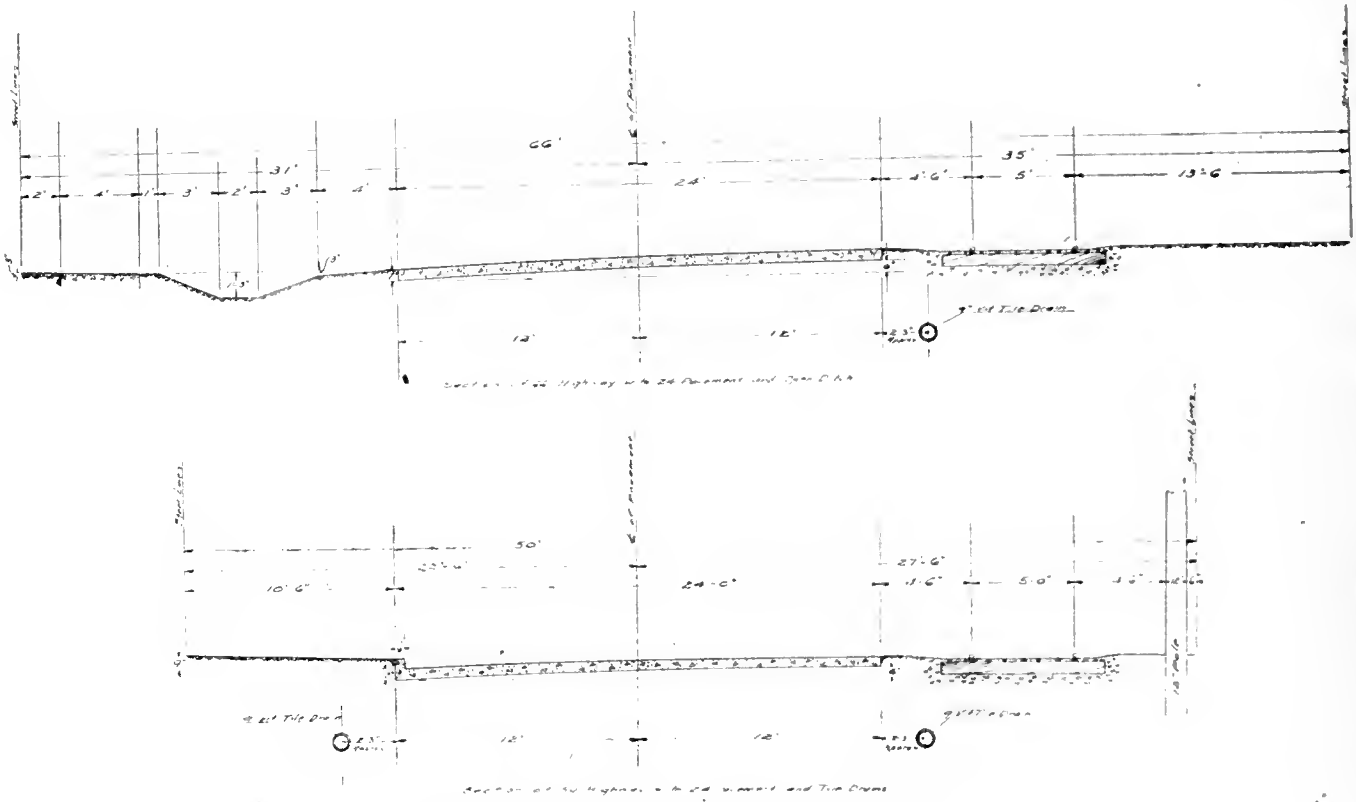

Fig. 8 (upper)—Cross-section of 24 ft. pavement with open ditch.
Fig. 9 (lower)—Cross-section of 24 ft. pavement with tile drains.

gether by means of horizontal members, placed so as to give a minimum clearance over the roadway of 16 ft. The clear width of the roadway is 20 ft., while the clear opening under the bridge is 119 ft. 4 in.

A bridge practically identical to the one over Etobicoke River will be erected over the Bronte Creek, the only difference being a slightly different span, while the abutments are in reinforced concrete.

An arch bridge similar to the Mimico Creek bridge was designed for Port Credit, with a clear span of 126 ft. 6 in. The rise of the arch is 1:12.5. Unfortunately, the above structure was not able to be adopted on account of the rather excessive cost, and a structure similar to the preceding one, but with steel handrailing, was designed, showing a saving of $6,100.

That the cost of the arch ring structure compares so unfavorably with the overhead arch rib type is due to the poor foundation, the rock not being reached until about 50 ft. below the level of the roadway. As the overlying earth is silt, it was necessary to take the whole of the thrust down to rock, which was done by means of reinforced concrete piles driven to a batter and able to carry as much as 90 tons each.

The bridge likely to be constructed is, as indicated above, of the same type as the Etobicoke bridge, with the same widths of roadway and sidewalks and the same span.

A word regarding the amount of traffic on the highway may be of interest. In 1914 the highest traffic recorded at any point on the Lake Shore Road was 520 per day, of which 262 were pleasure motor cars, 3 commercial motors, and 199 horse-drawn pleasure vehicles and 56 horse-drawn commercial vehicles. A traffic count by the Commission in 1916 showed a grand total of 3,254, of which 1,876 were pleasure motor vehicles, 142 commercial motor vehicles, 271 pleasure horse-drawn vehicles and 184 commercial horse-drawn vehicles.

In October this year a maximum count of 3,840 was recorded, of which 3,065 were pleasure motors, 107 commercial motors, 148 pleasure horse-drawn and 41 commercial horse-drawn.

A count in 1918 with the York County section open for use will undoubtedly show at least twelve times as much traffic as in 1914. Is it any wonder that the types of construction suitable ten years ago will not give satisfactory service today?

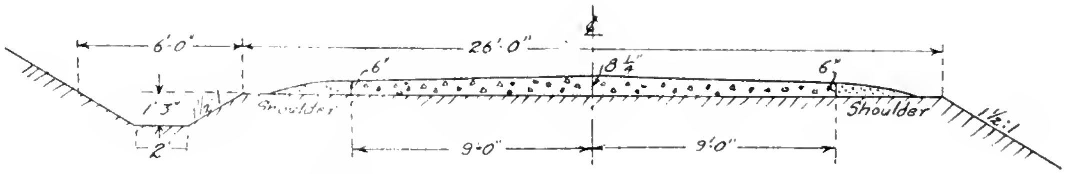

Fig. 10—Standard road section on Toronto-Hamilton highway.

Lands & Buildings, Limited, Montreal has been incorporated with a capital of one million dollars, to erect buildings and deal in building materials; to purchase, lease, and otherwise acquire land and buildings; to carry on the business of general contractors, etc. Messrs. H. W. Jerry, Lionel Kent, A. Leonard, L. P. Goyette, and A. Raymond, Montreal, are interested.

Safety in Scaffolding Construction

Care Must Be Used in Erection of Scaffolds to Eliminate Insecurity and Danger to Workmen—Prevent Overloading

By Elmer Spahr

LITTLE has been written concerning scaffolds with reference to safety and efficiency, considering the wide use of scaffolds and that many accidents are caused by faulty construction or over-loading.

When it is considered that no building can be constructed without the use of a scaffold, of some form or other, and that the men employed at the building trades perform nearly all of their labor on a scaffold, there should obviously be much thought given to careful construction.

The fact that scaffolds are merely temporary affairs, to be used only for a short time, should not preclude the idea that they should be as carefully planned as the building itself. In most cases the planning and building of scaffolds are usually done with the easy removal of the scaffold after it has served its purpose as the principal object. On this account many minor and often disastrous accidents have occurred.

One must realize that the mechanic cannot render efficient service while working on a staging that is weak or narrow or where the footing is very uneven, because under such conditions his brain is crowded with thoughts concerning his safety. This makes it impossible for him to concentrate his attention on the work he is performing.

Safety Little Considered

With the exception of creating a few patented scaffolding devices, safety engineers have given this matter very little attention, although other lines of industry have received careful thought and planning to prevent the worker from injuring himself or being injured while engaged at his daily labor.

Unlike many of the other victims of industrial accidents, the workman injured from a scaffold is in no way responsible for the accident, as the scaffold is usually erected by another workman who does not intend to work from it, but who does intend to wreck it when it has served its purpose. Personal observation has demonstrated that seldom is only one person injured in the collapse of a scaffold, but frequently several, and instances of six and of ten men have been known to go down in a scaffold fall. A single collapse has been known to result in the death of several men.

The bricklayers or masons, for instance, when ordered upon a scaffold by their foreman, assume that the superintendent has provided for their safety, when it may be that the person who erected the scaffold did not consider the weight of numbers of bricks, hods of mortar and cement, and the additional live load of mechanics and their helpers. The resultant stress may be too great for an upright, a ledger, or perhaps a putlog which breaks, taking a whole section or more, precipitating the men and the mass of material to the ground below. One can readily make an estimate of the results in death and injuries, depending on the distance of the fall.

The object of this article is to call the attention of builders and others in the allied industries to the seriousness of the accidents due to faulty scaffolds and to offer suggestions to prevent them.

Each Building Treated Individually

While it is true that in modern construction, each building presents an individual problem of scaffolding, there are many suggestions that can be considered to advantage in the erection of all scaffolds. The most widely used scaffold for masons is built with "horses" in their various forms. The stiff-legged "horse" is most desirable. As there is no necessity for nailing braces, it is easily constructed and can be removed without the usual waste of broken braces. However, as such scaffolds are somewhat bulky, they are expensive to move from one operation to another, so that some contractors use a "horse" with hinges, fastening the legs to the putlog or cross-piece so that the "horse" can be folded, thus occupying less space when loaded on a car or truck. When this style of "horse" is used, it should always be toe-nailed to the floor, as a laborer accidentally striking a leg with a barrow may wreck a section of the scaffold.

Another form used is the square, made from two pieces of 2 in. x 4 in. x 5 ft. for the uprights with two pieces 1 in. x 6 in. x 4 ft. 6 in. in length for the top and bottom. This makes a good scaffold when properly braced. The practice of driving nails only part way and bending them over when fastening braces on this kind of scaffold has been the cause of many minor accidents, because, frequently, in trying to climb on the scaffolds, workmen may pull the braces loose, causing backward falls which often result in injuries to the spine or head. Again, the sudden removal of a brace in this manner sometimes causes the collapse of a section of scaffolding with more serious results.

Pole Scaffolds up to Six Stories

As this form of scaffold is only profitable and convenient on the inside of buildings, or for a short distance on the outside, the pole scaffold is used for greater heights. The pole scaffold is responsible for more serious accidents than all the other forms of scaffolds combined. It is used on the outside of buildings to a height of five or six storeys, when there is no steel frame in the structure, and it is often subjected to great weight. For this reason great care should be used in its planning and construction. On four-storey buildings the poles should be of selected stock 3 in. x 4 in. straight, free from bad knots and other imperfections, sawed square at both ends, so that there may be a proper footing and that succeeding pieces may have a good bearing when spliced. The poles should have a good footing on the ground and be secured at the bottom.

As conditions vary greatly with each operation, and often on the same operation, detailed advice can hardly be given as to the method of fixing a pole at the bottom, but the practice of resting and securing them to a sill is a method that can be used in many instances to a good advantage, where the surface is soft or uneven; or, on sidewalks, on roofs of adjacent buildings, and in almost every condition encountered.

When one considers that wagons are likely to be backed against an upright, or that they can be struck by the end of a beam, or that some teamster may unload lumber against the scaffold, it will be realized that it is necessary to make the bottoms doubly secure.

The Ledger an Important Part

The ledger, or horizontal stringer, is another important factor in this scaffold, and the size should be governed by the weight it must bear.

When a ledger is nailed to a pole, a pole should never be left until the required number of nails (usually eight 10-penny nails) have been driven into the pole. Numerous accidents have been caused by a workman driving one nail into a ledger, leaving it to secure the other end and then forgetting to return and properly secure the first end. It is preferable to nail the ledger on the inside of the pole, for several reasons. It is more convenient to nail when standing on the platform, the nails being always in plain view; there is no obstruction on the outside of the pole to interfere with the braces being nailed directly to the poles; also, the shorter span for the putlog makes for safety.

The distance between the ledgers is governed by the work to be performed on the scaffold. For bricklaying and masonry, the ledgers are usually spaced five feet from top to top. Nailing a cleat under the ledger is a simple plan that is strongly recommended for safety.

In placing the putlogs, they should have at least four inches hold on the wall and should project sufficiently over the ledger to give good bearing, cut not less than six inches. The stock should be at least three inches by four inches and free from knots and placed narrow side up. Very recently in an eastern city, two men were seriously injured by a frozen knot in a putlog breaking. It is impossible to use too much care in selecting good putlogs and in spacing them properly.

The Platform

In placing the plank for the platform, which is usually four feet wide, care should be used that the plank rests on all the putlogs, so that an even distribution of weight will be obtained. Frequently, it is necessary to nail a furrowing strip to the top of a putlog to bring it to the proper height on account of the overlap of the plank. A foot board should be nailed to the outside of the platform to prevent material falling on passersby or workmen below and a guard rail should be at a height of about three feet six inches from the platform for the safety of the workman on the scaffold.

The bracing of this form of scaffold should receive every attention, and as frequently as possible, braces should be nailed to the floors of the building, through the windows, to prevent the scaffolding from pulling away from the building.

The poles should be inspected frequently at the bottom to ascertain whether they have been displaced from their foundation or whether they are sinking into the ground.

Suspended Scaffolds on Concrete and Steel Structures

The suspended scaffold is a comparatively recent invention, and is used only on buildings having a concrete or steel skeleton, with a height over five storeys. As the name implies, the platform is suspended from above, usually on steel cables fastened to a thrust-out or outrigger, on the roof or some floor above the point where construction or bricklaying is being done.

Not many accidents have been reported due to the breaking of this form of scaffold. On the other hand, accidents may occur on these scaffolds due to the lack of safety precautions. As these scaffolds are nearly always used for bricklaying or terra cotta setting, it is necessary to have a foot-board and guard-rail with a wire netting fastened between the toe-boards to prevent tools and fragments of material from falling to the ground. In most instances where these safety measures were not employed, tools of various descriptions, bricks and other material fell, causing injuries and resulting in damage suits.

To protect the men on a scaffold from objects falling from above, a roof should be constructed directly over them. This can be done where the overhead drum is used, by clamping a 2 in. x 4 in. putlog on the cable and laying inch boards. Where the drum is on the platform, the machines are provided with uprights to support the roof or covering. On some buildings planks were placed on the outriggers, in some instances six storeys above the workmen, and afforded no protection whatever.

Care should be taken in lashing the scaffold to the building, so that it will not move away when the workman pushes against the wall. This sometimes happens when putting sills, lintels and terra cotta in place, causing the workman to lose his balance and fall between the scaffold and the building.

Care Against Overloading

As it is customary to stock this scaffold with material after the masons or bricklayers leave in the evening, care should be used not to overload. An instance of a scaffold being overloaded is known where the cable outriggers and platform stood the strain, but when the bricklayers came on the scaffold in the morning, the roof beams upon which the outriggers rested, gave way and only by an act of Providence was a disastrous accident avoided.

The high cost of lumber, the scarcity of workmen and the increased wage have all had a tendency to make for insecure scaffolds.

No matter what kind of scaffold is being built, a plank should never project more than a foot beyond a support unless a guard-rail is placed to prevent the workmen from walking on the unsupported platform and receiving a fall.

When the employer realizes the loss, not only to the workman, but to himself in material, and in time while constructing a broken scaffold; when he realizes the fact that he is responsible in a measure for someone being a cripple; and when he also realizes that a workman can only deliver the maximum amount of service when he is positive that the scaffold upon which he stands is secure, then will there always be secure scaffolds. If "Speed at any price" is to be the motto, there will be scaffold accidents.

The St. Maurice storage dam, being constructed by the St. Maurice Construction Company, Montreal, for the Quebec Streams Commission, is nearly completed. The dam will be of great value to power and other companies with plants on the river, enabling them to largely increase their power requirements. The companies will pay annual charges based on the quantity of water utilized.

The John S. Metcalf Company, Limited, Montreal, have prepared plans for a number of government grain elevators to be erected in Victoria and New South Wales, Australia.

Paving Parkway Drives and Boulevards

WHILE paving practice for city streets has become fairly well standardized, with a consequent accumulation of data on construction and maintenance methods, the amount of really useful information on the less heavily traveled parkway drives and boulevards is comparatively meagre. The following article, by S. Whinery, from Engineering News-Record, therefore, should appeal to a wide circle of city engineers and road officials, most of whom are responsible for a certain mileage of park routes. The bituminous carpet on concrete base is the type advocated by Mr. Whinery, who lays particular stress on two points which are held to be all-important if this form of construction is to be a success.

The revolution that has taken place during the last three decades in the character of the travel over our park drives and boulevards has made necessary a radical change in the kind and character of pavements for this class of highways. It is admitted by all that the waterbound macadam and gravel pavements, so well suited to the earlier conditions, are inadequate where rubber-tired wheels prevail. The problem of the present is to find the best and most economical pavement to substitute for them to meet present conditions. This problem has not yet been satisfactorily solved.

Durability Not Necessarily a Controlling Factor

What is needed is a pavement that shall be smooth, dustless, easily cleaned, not slippery, and that can be constructed and maintained at so low a cost as to be most economical. Great durability is not necessarily a controlling factor except as it may affect ultimate economy. Broadly stated, the element of economy resolves itself, other things being equal, into the question: What pavement can be constructed and maintained through a long period of years at the least cost per square yard per year? In other words, what pavement will give the largest returns in satisfactory service for each dollar invested in it?

The writer is of the opinion that these requisites will ultimately be found in what is called a bituminous-carpeted hydraulic-concrete pavement. This type of pavement is not new, but it is still in the experimental stage of development that all our standard pavements have passed through. Most of those so far built give promise of reasonable success, but there have been not a few failures. This was to be expected when we consider the differing materials used and the varying methods of construction followed. Most of the failures to secure satisfactory results are, in the opinion of the writer, due, in some degree, to the use of inferior materials, but mostly to faulty construction.

We must constantly keep in mind that any satisfactory pavement must possess two primary requisites—it must have the supporting strength to carry the maximum wheel loads to which it will be subjected and the ability to resist the surface abrasion and wear of travel. The first requisite may be met with a good concrete foundation. We now have ample knowledge and experience, if intelligently applied, to guide us in the design and construction of concrete pavement foundations, and little need be said on that subject.

But in the matter of bituminous carpet-coatings we greatly need further knowledge and experience. The best material to use, its proper preparation, its consistency, and the methods of its application are all matters about which there is more or less difference of opinion and practice among engineers. It will probably be found that the best material (bitumen) for the purpose is a natural asphalt, though there is evidence that some of the coal-tar preparations will give good results. The exact composition, consistency, and treatment of the bitumen that will give the best results cannot yet be stated definitely—it will vary more or less with conditions of travel and climate.

Add Mineral Dust

Our experience with sheet asphalt and other bituminous surfaces should help us here. In carpet-coating work we have apparently overlooked the very important function of colloidal matter—mineral "dust" as it is called in the asphalt paving industry—in increasing the toughness and wearing qualities of bituminous cements. The writer's first suggestion is, that the bituminous cement should be specially prepared by the intimate admixture with the melted bitumen of as much such "dust" as it will carry without impeding the spraying of the mixture on the street. Not less than 25 per cent by weight doubtless can be and should be used—more if possible. In asphalt pavements the weight of the dust used is often almost equal to that of the asphalt cement. The consistency of the bituminous cement will vary with conditions, but we safely may say that it will be harder than the heaviest road oils and softer than the asphaltic cement for asphalt pavements.

In the methods of applying the two coatings of cement to the street, the quantity to be used, the application of screenings or gravel and the rolling, present best practice is, probably, about right—subject, of course, to further experience.

Adhesion of Bituminous Coat

The most frequently observed and most serious source of trouble with bituminous carpet-coats on concrete roads is the failure of the coating to adhere to the concrete. The practice is almost universal of finishing the top of the concrete with a surface of rich, fine concrete or mortar alone, gauged to the proper grade and practically "troweled" so that it sets to a smooth, dense, glassy surface almost, if not quite impervious even to water. The liquid bitumen does not penetrate or "take hold" of this surface even when perfectly dry, and if the concrete is damp the hot bitumen generates a film of vapor between the two surfaces, still further preventing proper adhesion. The result is that under travel the carpet-coat is easily displaced, breaks up, and is carried away, leaving the concrete perfectly bare.

This defect should be easily remedied. Since the resistance to abrasion is no part of the intended function of the concrete foundation, the rich, dense, glassy finish is not necessary. If ordinary good concrete is used throughout, its top surface gauged to the true grade, and compressed by tamping, or, what is far better in this case, rolled with a hand-roller, say 30 inches long and weighing about 750 pounds, such as is commonly used in the asphalt pavement industry, an ideal surface should result. It will be true, hard, and strong, but not dense or glassy, and the hot bitumen will penetrate it slightly and become firmly anchored thereto. It will be noted that recently many engineers of experience in this line of work require that the concrete shall be thrown open to travel for some months, or even years, before the bituminous coating is applied. The rationelle of this practice is, obviously, to secure the roughening of the surface of the concrete so that the bituminous coating will adhere to it. Why not suggest this effect at once by the treatment here suggested?

Differs in Two Particulars

It will be noted that the construction herein suggested differs materially from approved present practice in two particulars only—the special preparation of the bituminous cement by the addition of mineral colloidal matter and the finishing of the concrete with a somewhat rough and porous surface. Other details of some importance might be discussed, but the length of this article forbids; and they may safely be left to the intelligent engineer.

A pavement for parkways and boulevards of this type, when further experience shall enable us to perfect it, should be comparatively low in first cost and cheaply maintained. It is true that, with present prices of portland cement, no pavement with a concrete foundation can be built very cheaply, but if the carpet-coat can be made to shield the foundation effectually from wear, the latter should be practically permanent. The bituminous surface coat should be quite inexpensive, and, even if it should require renewal every four or five years, the average cost of maintenance per yard per year should be quite low.

Cast Iron Water Pipe in Service for Half a Century

THE long life of cast-iron pipe is a matter of general knowledge, but some actual records of its use in water supply lines for railways which have recently been determined should prove of value to those concerned with water service installation. Instances of old installations of cast-iron pipe have recently been investigated on the Illinois Central Railroad, with the result that the life of several of these lines have been traced accurately down to the present time.

Service for 47 Years

The most interesting case is that of a line of 4 in. pipe approximately 10,000 ft. long, which was laid at Centralia, Ill., in 1855. In 1867 the pipe line became inadequate for the water consumption, and upon examination it was found to be heavily encrusted. Efforts were made to improve its capacity by cleaning it and relaying part of it with clean-out boxes at 100 ft. intervals. Only temporary relief was afforded, and in the following year about 5,000 ft. of the line were taken up and relaid with 8 in. pipe, which is still in service after being in the ground for 49 years. The 4 in. pipe removed at Centralia was relaid in 1868 or 1869 at Ramsey, Ill., and remained in service until 1903, when it again became too small for the demand, and was replaced by 6 in. pipe. Since that time the old 4 in. pipe has been used as drains at a number of places.

Some of the 8 in. pipe laid at Centralia in 1868 was taken up when the shops were abandoned in 1916. It was found to be in such good condition that most of it was re-used, no distinction being made between the old pipe and new cast-iron pipe. Other examples of long life of cast-iron pipe on the Illinois Central include one of 7,500 ft. of 4 in. pipe at the Little Wabash River, which was laid in 1857. This remained in service until July, 1893, when it was replaced by larger pipe. Some of the old pipe was relaid at Centralia in 1894 and 1895, and is still in service. No signs of paint can be found on the pipe at the present time, and apparently it had never been painted. There is also a line of 3 in. pipe, 1,175 ft. long, which was laid at Correctionville, Iowa, in 1887, and is still in use, and a line of 4 in. pipe, 2,962 ft. long, which was laid at Webster City, Iowa, in 1869, a portion of which is still in use. A line of 4 in. pipe, 1,740 ft. long, laid at Cherokee, Iowa, in 1870, remained in service until 1900, when it was abandoned on account of a change in the water supply arrangements, and a 3 in. line, 606 ft. long, laid at Gaza, Iowa, in 1888, was abandoned in 1911 on account of the destruction of the water plant by fire.

Effect of Encrustation

The tendency of cast-iron pipe, in common with other types, to become more or less encrusted with the lapse of time has no bearing on the life of the pipe, as it can be cleaned from time to time. In 1913 the Illinois Central experienced difficulty of this nature with an 8 in. line supplying water from the Big Muddy River at Carbondale, Ill. This pipe had become so encrusted that a pressure of 140 pounds per square inch was required at the pump to deliver 400 gallons a minute, which indicated that the capacity of the pipe was reduced to approximately that of a 5 in. pipe. Upon examination it was found that the diameter was reduced to about 7 in., involving a large increase in the friction factor as a result of increased roughness. A contract was let for cleaning the pipe under a guarantee that it would be restored to 95 per cent. of the discharge capacity of new pipe. The encrustations removed were estimated to represent about 16 tons of material, and the work was done without taking the station out of service for more than a few hours at a time and with no interruption to train service. When the cleaning was completed a test run on the pump gave a discharge of 498 gallons a minute for an average pressure of 70 pounds per square inch.

The early cast-iron pipe is characterized by a bell that differs from the standard designs of the present time, by the presence of two reinforcing rings or enlargements at the third points of the pipe, and by inequality in thickness resulting from the practice of casting the pipe with the mould in a horizontal position. Measurements indicate an average thickness of about 3/8 in. after 62 years of service, as compared with a probable original thickness of shell of 7/16 in.

Ottawa Branch C.S.C.E.

About 70 members of the Ottawa branch of the Canadian Society of Civil Engineers and other guests on October 20 visited the new filtration plant at Aylmer, by invitation of the Mayor and Council. The plant was designed by Mr. J. O. Meadows, A.M.C.S.C.E., Montreal, and the contract carried out by R. T. Smith & Company, Westmount, the equipment being supplied by the New York Continental Jewell Filtration Company, Montreal. The Ottawa members were conveyed by special car to Aylmer, where luncheon was served.

Afterwards Mr. H. L. Seymour, A.M.C.S.C.E., read a paper describing the plant. Speeches were also made by Mayor Dubyrne, of Aylmer, Mayor Fisher, of Ottawa, Mayor Archambault, of Hull, and Mr. Fraser S. Keith, secretary of the Canadian Society of Civil Engineers, who made his first official visit to the Ottawa branch on October 19 and 20. The visitors to Aylmer subsequently inspected the plant.

Wherein Technical Education is Deficient

Modern System Aims to Provide a Knowledge of Practical Affairs Rather than Develop Qualities of Character and Scientific Outlook

THE problems which come before the engineer in his day's work are either human or scientific, or a blend of the two. The success of his work depends largely on other men and their efforts, and his scientific knowledge may be rendered valueless through his inability to employ and control the proper type of subordinates. Colonel Goethals has said that the building of the Panama Canal was less a problem in engineering than a problem in social science, and he attributes its success less to management of material than to management of men. It is peculiar to the trained man that he is the link between two different classes of men. Hence it is that he is beset on both sides; acting between management and workers he must compromise between impossible commands coming from above and veiled threats coming from below. His position all the time makes demands on his quality as a man as well as on his judgment and knowledge as an engineer. In this connection it is interesting to note the result of a symposium held by the committee of the Carnegie Foundation for the Advancement of Teaching among members of national engineering societies to list the qualities desirable in young engineers. The order given was as follows:—

I. Integrity. Resourcefulness. Judgment. Thoroughness. Executive ability.

II. Knowledge of the fundamentals of engineering. Technique of practice and business.

Conditions of Success

The technical college of to-day and its students seem to have lost sight of the need of the first group of qualities, in specializing on the second. The effort has been to train a man who will be an engineer immediately he leaves college. To some extent it is successful, but he is a forced growth. He can make a brilliant beginning. He is at once at home in manufacturing shops and in the routine of business. But his knowledge is knowledge copied from others; his facts are facts which were poured into him. He is accustomed to having things made easy, to having others do his thinking for him. He finds new things very strange, and hard things impossible, when he has no guide at his elbow to point out the way. He does not develop; in spite of his flying start he is unlikely to make rapid headway, and all his life he will fill but a mediocre position in a mediocre way. The young engineer of to-day is lacking in character. He has knowledge—knowledge of scientific principles, of business, of workshop methods, and of the handling of material. Success, however, is not dependent upon such knowledge, and if he has not self-knowledge as well his facts will not carry him far. Many engineering graduates, finding progress slow, leave the first positions they have gained, make periodical changes, and after a few years find themselves far behind those dull plodders who possessed the qualities of patience and perseverance. If there is one quality more necessary than any other to the engineer for both his success and his own happiness it is patience. He must, above all things, know how to wait. He has a business to learn after he leaves college, and no matter how great his knowledge of practical affairs, he must learn it step by step. Progress is necessarily slow, and depends not on the amount of knowledge with which he begins, but on the scientific attitude and fibre of the man himself. It is a hard lesson for the young graduate full of big ideas for the immediate reorganization of the business into which he enters. He is impatient and wishes to strike out on a new line, to do things in new ways and astonish the world. He has to learn that he can advance only along with others, that his work is bound up with wide and varied interests and has many unexpected ramifications, and that his road to success lies along lines laid down by others and in co-operation with them.

Defects of Usual Training

The chief fault of modern technical education is that it does too much for the student. It lays itself out to give him great quantities of knowledge, and to do so simplifies and systematizes his work to such a degree that he tends to become a receptacle for undigested facts. He goes through a perfectly prepared and thorough workshop course, sometimes in college and sometimes in outside works, and with it his lectures and his theory are perfectly co-ordinated, so that without effort he gains a wide acquaintance with the practical methods and appliances of modern industry. But his knowledge is superficial, he is arrayed in it as the modern young man is dressed by his valet, and he never realizes his helplessness till he is left without help.

The whole system is based on the idea that a college should produce graduates with a knowledge of practical affairs. The student is treated as though the actual knowledge of machines, processes, and materials was of value, whereas in itself it is practically worthless. The great and precious value of practical experience to a student is that by it he gains self-knowledge through his relations with others and through the unexpectedness of its daily calls on his character as a man. If a works course is so co-ordinated with lectures that the acquisition of knowledge is systematized and made easy it cannot be made to do duty as experience; the student is simply leaving one class room for another, and is being carefully preserved from the conditions of reality.

The Teaching Staff

The institution which aims at efficient training of technical men must give them a twofold education. It must give them a thorough grasp of those scientific truths which lie at the root of all realities, and it must develop their character and their sense of individuality; and to balance these two purposes against the future needs of the students it must provide an engineering atmosphere in every class room and laboratory in which they work. For this it is essential that the men who guide them should be engineers in the broad sense of the word. They should be fresh from contact with business and industrial activity, and that contact must be constantly renewed, for an engineer who withdraws from practice to take up a professorial career insensibly grows out of touch with business life and becomes "academicized." Either engineers in actual practice should be employed as lecturers or the teaching staff should be renewed every three to five years from men who have been in practice. The former method is perhaps the more feasible.

If possible mathematics, physics, and chemistry should be taught by men who are not remote from the business world, but at all costs let them be thoroughly taught, and in such a way that the student can apply their results with facility. If he has his first principles thoroughly grasped he can remedy any defect in his mental equipment after his college years, but they must be taught in college to be assimilated, and give that scientific outlook which is the hall-mark of the true engineer. If the teachers of these subjects must be specialists in them, and as such out of touch with business affairs, it should still be possible to have assistants in the mathematical, physical, and chemical departments of the college who have had some variety of engineering experience, and who will help to preserve an engineering atmosphere even in the class rooms of pure science.

Specialization and Special Study

Finally, the institution which proposes to supply the demand for trained technical men should devise a system by which the student is encouraged to take an active interest in some particular section of engineering work, and to pursue a study of this "specialty" during his four years in college. This is a very different thing from saying that he should specialize in some branch of engineering in the endeavor to enter his profession at the same time that he enters college. The boy who tries to specialize in what he thinks is going to be his life's work is blind to the true purpose of education. It is, as Mr. W. L. Hichens said in his address at the annual general meeting of headmasters, "not to teach him how to earn a livelihood, but to teach him how to live." It will be time enough for the engineer to specialize when he has added half a dozen years of experience to all that college has taught him; and his education should be broad enough to enable him after that time to specialize in anything within the limits of his profession. The special study of some section of engineering work or industrial activity is the most valuable work a student can do during his college years, not because of the knowledge of special facts which it will bring, but because of the perfect course of mental training which it will provide if properly carried out. It should be continuous through college and complete in college. He may turn aside from his "specialty" on his graduation and take up some utterly different branch of work without impairing the value of his training, for this value will be in the development of those qualities and scientific outlook so necessary to the young engineer.

Aims in Specialization

Take the student at the time of his entrance into college. Generally speaking, he will have inclinations in some particular direction—towards some branch of electrical, mechanical, or civil engineering—and an enthusiasm which will readily respond to any encouragement of his tastes. With the resources of the college library at his disposal he will have an opportunity of studying the history of what may be called his "specialty," becoming acquainted with its modern developments and gaining a general idea of how these developments are affected by business conditions, and so fixing his ideas, which were probably very vague to begin with. This general study should easily be accomplished during his first year, and with a fair amount of tactful help from his tutors it is almost certain that his interest in the particular subject will be fired.

During his second year he will be given an opportunity to study the more technical aspects of his "specialty" and associate them with those scientific principles with which he has become acquainted in the class-rooms. It matters not what subject he has chosen—motor-cars, railways, ships, machine-shop appliances, paper manufacture, factory efficiency and management, reinforced concrete work—all these and any other within his choice are built upon the same fundamentals and have in every direction the truths of science woven through them. Their unlikeness is only on the surface; beneath they have endless points of contact and in studying one of them and strengthening his knowledge of it by relating it with his theory he is learning the true meaning of all engineering.

If by careful supervision his interest in his subject has been thoroughly aroused during his first year, he will go ahead under his own power. The stimulus of enthusiasm and self-conceit will give a driving force to his efforts which will carry him along easily. He will be as different from the student whose mind is occupied with plans, hopes, and fears for his fate after graduation as a man who goes on a journey with interests by the wayside from him who starts with nothing but anxiety and impatience for his journey's end.

The student's special work will be peculiarly his own. He will be free at certain hours to study it or not as he wishes, in college or outside. He may of his own accord seek help from his tutors, but supervision will be reduced to a minimum. Freedom must exist if he is to obtain the full fruit of the system. With some it may be unsuccessful, but such have not the qualities of mind necessary for engineers, and early realization of that fact would be a benefit to themselves and to their profession. With most, however, the self-dependence involved would be invaluable as a means of developing their individuality and in bringing out and fostering those qualities on which their future success will depend.

Value of Research Work

In the latter part of his course, as his knowledge of his specialty grows, the student will invariably feel that here or there is a need of reform, or an opportunity for the introduction of improvement; and during his final year with some new idea as a basis he may attempt individual research. It may be crude, it may be a repetition of what many others have done far more perfectly, it will probably be valueless so far as the direct advancement of the science or industry of the country goes; but it will develop his mind and character as no other work can. He will have his first experience of the widening out of the simplest problems when one tackles them practically. He will be impressed with the necessity of narrowing down his demands to the means at his disposal. His relations with others, his patience, his accuracy, his foresight, will be exercised and developed in a thousand different ways, and in the end he will have an opportunity of combining all his knowledge and learning a new lesson in drawing conclusions from facts actually observed by himself irrespective of all preconceived ideas. With this his college training and his study of his "specialty" may finish.

The key to the success of this system lies in the awakening of the student's interest in a subject suited to his taste and ability. To secure this it will be necessary to treat every student as an individual. A heavy burden of work will thus be thrown on the teaching staff, but individual capacity will be discovered, instead of being crushed, as it is under systems which regard the students as so many units, and the driving power of individual enthusiasm will be given to the educational machine. Throughout the four years' course the study of his "specialty" will have a unifying action on the student's work, giving a flesh and blood meaning to the abstract principles of pure science on one hand and on the other keeping him in touch with the practical world and business affairs. Whether on graduation he obtains an opening suited to his special knowledge matters little; he has in himself the elements necessary for success—the machinery required to deal with men and facts in a scientific way. With time and experience he will "find himself."

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Solving Industrial Housing Problems

Bulletin of Portland Cement Association Shows Where Concrete Has Advantages for Community Developments

MODERN industrial buildings are now planned for fire-safeness, for sanitation, for general safety, and for every other end conducive to the health and welfare of the workers. The increased efficiency of workingmen resulting from a better working environment represents good profit on the investment necessary to secure it.

Although many corporations have given a great deal of attention to improving conditions under which their workers labor, few have given much attention to the conditions under which these men live. Yet it has been proved by those who have studied the problem that betterment of living conditions is vital to plant efficiency. In these days efficient workingmen are not willing to live in shanties. The lowest foreign-born element soon becomes enough Americanized to demand many, if not all, of the home advantages and surroundings that the native-born American regards as his birthright.

Better workingmen's homes are now being provided by many of our foremost industries. If they are not provided by or near the industry which employs him, the workingman will become dissatisfied and will go where congenial home surroundings and social advantages can be secured. This is especially true in these times, when speeding up of industries due to war's demands, has multiplied opportunities for the workingmen to choose employment to his liking. With such opportunities are wage increases that make former jobs and living conditions unattractive.

Concrete the Solution of Industrial Housing

The problems of modern industrial plants from the building standpoint are now largely solved with reinforced concrete construction. Moderate first cost, fire-safeness, sanitation, possibility of maximum light, elimination of maintenance, are some results secured with concrete that makes the concrete factory building an attractive investment. And it passes on to the workingman benefits similar to those which accrue to the owner.

Realizing that conditions outside of the plant are just as vital to the workingman's contentment as are conditions in the plant, it is time that living conditions for the workingman were more generally improved. Welfare activities of many organizations include insurance and pension systems, profit-sharing or bonus plans, saving banks, building associations, commissaries, free legal advice—all of which are not only of benefit to the recipients but also to the concern whose foresight prompted their inauguration. Most of them develop contentment in the workingman that is identified with the home as well as with the factory.

In the average industrial town the workingman of limited means too often finds that his home is little better than a shack. The man who can pay but nominal or little rent goes unprovided for, or must live in cramped, unhealthful surroundings. Such conditions are common also to congested districts in our large cities, where the problem of providing homes suitable for workingmen of moderate means is one of vital concern with respect to the health and general welfare of every citizen.

Several of our modern industrial towns are practically concrete built. In many of these the entire community development, which includes all town planning, such as streets, alleys, and homes, has been worked out largely with concrete construction.

Advantages of Concrete Houses

Concrete consistently used produces a fireproof structure. Fireproofness suggests permanence, and permanence brings us face to face with the fact that expensive upkeep is eliminated.

Concrete construction represents the true investment side of home building. Any investor wants to know that his fixed charges will be reasonably low. An investigation of concrete buildings at once compels preference for this material from the investment standpoint. First cost is the only cost.

Concrete is rat-proof, vermin-proof, sanitary. These advantages, coupled with fire-safeness, afford comfort and security that are not fully realized when any other building material is used.

Conditions in the building trades are now such that concrete houses can compete successfully almost anywhere with any other type in first cost. Where there may be an exception to this statement, any slight increase in first cost is offset by the knowledge that a concrete house affords every security to health, life, and happiness that can be had in a home.

Concrete a Distinctive Building Material

The idea prevails in the minds of some that concrete is a substitute building material. This is not true. It can be used wherever any other building material can be used. It has superior merits to mark it for preference:

Most of the materials required are on the ground or near by.

Common labor, under competent supervision, can perform most of the work in concrete construction.

Speed of construction, when the ends attained are considered, is more rapid than is possible with any other building material.

Concrete structures are easily kept cool in summer and warm in winter.

Concrete increases in strength with age.

With the all-concrete structure first cost is the only one. Maintenance is eliminated.

Loss of the structure by fire is practically an impossibility; therefore, insurance need not be carried on the building.

Architectural Possibilities

Concrete houses can be designed by competent architects so that the intending builder can gratify his taste for almost any admired type of architecture. Any interior arrangement desired is readily adapted to concrete design. Wood window frames, doors, and other interior trim may be used in the concrete house, but metal trim and fireproof window frames, sash, and doors are preferable. Wood floors may be laid on top of concrete floors or linoleum may be used in a similar manner. The concrete floor properly finished is perhaps best. Very pleasing surface finish can be secured. The floor will be sanitary, more serviceable than any other type, and suited to any use proposed for it. Simple treatment makes a concrete floor ideal for dancing.

Types of Construction

Several distinct types or systems of construction have been developed for building concrete houses. Briefly these are as follows:

1. Walls, partitions, floors, and roofs of monolithic concrete construction, reinforced where and as necessary. Such houses are built by depositing the concrete mixture into previously erected forms of wood or metal.

2. So-called unit systems, which mean that slabs consituting walls and partitions, also columns and beams, are manufactured or precast at a place or in a plant arranged for the purpose; and, after the units have been properly hardened, they are brought to the building site and set in place in a very short time and at small expense. Walls, partitions, floors, and roofs may be solid or hollow.

3. Walls of concrete block or similar units, with partitions, floors, and roof as in the preceding system. Walls, partitions, floors, and roofs may be solid or hollow.

4. A metal frame, resembling that used in a house built of wood, to which metal lath or fabric is fastened and the exterior covered with portland cement stucco. Metal lath is also attached to this frame on the interior, which is plastered with ordinary plaster. Partitions may be of metal frame and lath, like the exterior walls, or of hollow cement tile or other fireproof partition material. Floors and roofs may be solid slabs of reinforced concrete or may have metal joists, covered by thin reinforced concrete slabs. Metal lath is attached underneath the joists, then plastered.

Hollow walls in concrete houses, regardless of how they may be secured, are quite desirable, since the air space so produced protects the interior of the house against sudden or extreme changes in outside temperature—contribute to keeping the house cool in summer and makes it easier to heat in winter.

The last possible measure of fire-safeness to the interior comes from concrete floors and all-concrete stairs. Treads, risers, and balustrade can be of solid concrete, thus making the staircase fireproof—a very vital feature from the standpoint of safety to occupants.

Consistent use of concrete means a concrete roof. This can be flat or sloping, as fancy or architecture may dictate.

Community Development With Concrete

Concrete houses fit in admirably with any landscape scheme. Good exterior appearance depends only upon architectural design and workmanship. Fireproof concrete houses help to reduce the cost of living. Insurance costs are lowered. Where industrial communities are developed with concrete improvements throughout, the neighborhood assumes a truly permanent aspect. Concrete streets and alleys ensure easy access for fire departments. Concrete paving, front and back, makes utmost cleanliness of surroundings possible.

High Wages Do Not Produce Contentment

There is not an instance where industrial housing has been worked out with particular reference to the comforts of those most interested—the workers—that their self-respect and general efficiency have not greatly improved. To-day the inducement of high wages without attractive home surroundings will not foster contentment in the workingman with his position. No matter how dirty his work may be, he wants to keep himself and his home surroundings clean. He has learned to appreciate and value attractive, comfortable, modern, sanitary quarters. He, as well as his employers, realize that these are conducive not only to his personal efficiency but to his health and general welfare. The concrete house makes these ends attainable.

For the untrained, ignorant foreign laborer who has not learned the value of these things the concrete house is still the solution. He is exceptionally difficult to provide for, because by habit due to lack of proper environment he is uncleanly and destructive in the use of whatever home he may occupy. He cannot afford to pay much rent, so the housing provided for him must consider a type of construction which is of low upkeep. He must be housed in a home that will provide for his general welfare as regards sanitary appointments and comfort, and also in one that will withstand the general abuse to which, in his ignorance, he is likely to subject it.

Opportunities in Salesmanship for Engineers

THE engineering profession presents a very broad field of activity, the extent of which is not properly appreciated by those most vitally interested. The limits are very hard to define, because they are gradually being extended by the discovery, in various lines of effort, that the engineer possesses the best fundamental equipment to secure results in many lines. The development of engineering courses of study to their present high standard in our universities and colleges has been due, very largely, to a demand for specialized training, but as the results of this curriculum in other than highly-specialized fields are being more fully understood and appreciated, the study of engineering is coming to be considered a fundamental —the best possible foundation for many kinds of work.

In the following article, by N. H. Jacobsen, in Municipal Engineering, the selling field is recommended to men trained along engineering lines. The engineer has received a training that especially fits him for this sphere of action which requires men of broad comprehension and practical training:

Many Engineers Get Side-Tracked

"With all its vast opportunities for success to the individual—success based on achievement of the highest order—there is something pitifully tragic about the engineering profession. The average engineer is the victim of the wrong idea. He has seriously and conscientiously set about thoroughly to prepare himself, omitting none of the steps necessary to secure proper equipment. His technical training completed, he has attacked the problem of practical engineering with energy and enthusiasm, and deserves to succeed.

Round Pegs in Square Holes

You engineers who embarked on your life work ten, fifteen, yes, twenty years ago, look back on the men who graduated with you—men who, with few exceptions, were alert, capable fellows. Some have achieved distinction, a large number have risen and are advancing, but too many are standing still or going backward. A few would have failed at anything, but most of them would not and should not. They are blindly devoting themselves to engineering as a highly-specialized vocation, to engineering in the narrowest sense. Here lies the tragedy that, in spite of what has been said and written about the opportunities for men with engineering training in that broader field of engineering, which overlaps other activities than technical work, men, without the proper temperament continue figuring stresses, designing or superintending construction, long after they have discovered that they are not suited for work of this nature. By virtue of hard work and the good qualities they possess they may manage to overcome the fault of inaptitude sufficiently to hang on, but they are not growing, and, in the true sense of the word, they never will until they find the solution in work of a different nature. Their happiness depends upon their finding it. It is the duty of our universities, our societies, and our engineering papers, without deprecating in the least the importance of technical work, to preach the gospel of "engineering the proper foundation for achievement in the business world."

Opportunities in Salesmanship for Engineers

Salesmanship is one of the important non-technical fields in which the engineer is making his mark. Here is a dignified calling where the opportunities are practically unlimited. The qualifications are hard to analyze, but the transformation of the salesman from the agreeable individual who can talk but is not familiar with what he is discussing to the man in possession of definite, accurate information, is due very largely to the men with engineering training and experience who are taking up this work. They have been taught to persevere, to concentrate on every problem, regardless of the difficulties, until they arrive at the solution. Sales results are nothing more nor less than the solution of difficult problems. The important methods of attack which apply are the same as those which must be used in the consummation of a strictly technical achievement. There are of course, questions of personality, of proper understanding of human nature, etc., but the environment of the engineer is such that he should possess these qualifications to at least as great a degree as any one. If he does not, this and any other work offers to him the opportunity of success only to the extent that he is able to overcome his personal handicap.

Proper Selling Field for Engineers

Although the engineer need not necessarily restrict his efforts to any one branch of selling, it is only natural that his services are particularly valuable in the sale of materials, equipment, etc., in the design or use of which engineering questions are involved. Even assuming that we consider this as defining the limits of the sales engineer's field of work, we will find that we have included a very large percentage of the things which are bought and sold.

And here the engineer is supreme. Ability intelligently to discuss a thing can come only from exact knowledge regarding it. Only the product of merit can survive, and the extent to which it is used will depend upon two things—i.e., how meritorious it is and how carefully and accurately its good points are explained to the prospective buyer. The accomplishment of the latter is the business of the salesman, and the engineer has such a distinct advantage over the type of men who, until recently, have been devoting themselves to this work that he stands head and shoulders above them. Their only chance to reach the top or to stay there is by acquiring for themselves some of the things which the engineer already possesses, and that is what the ordinary business man, engaged in the sale of what we may for convenience call "engineering products," has been forced to do in order to keep abreast of the times.

Engineers, Purchasing Agent, and Salesman

Organizations which are large buyers find it necessary, in the interest of economy, to have their engineering and purchasing departments work hand in hand. An engineer prescribes what is to be bought, and the successful proposal must have his approval before the deal is consummated. If the purchasing agent is a man with engineering training, so much the better (and here I may incidentally hint at another field that is open to the engineer), but the important fact which I wish to bring out is that there is an engineer on the other side of the fence, and the only man who is thoroughly competent to cope with the situation is the sales engineer. Often there is only one product which exactly meets the requirements, and the sale is practically made before it reaches the purchasing agent. Our friend has been "on the job."

Selling Offers the Engineer Economic Salvation

The idea that his profession is narrow and that there are definitely defined limits beyond which he should not step must be dispelled from the mind of the engineer. To the young man who is trying to make up his mind regarding the selection of a life work, who would like to take up engineering but hesitates, let us say go ahead, you cannot make a mistake in this choice. To the graduate of our technical schools, who looks out upon the world and is discouraged because there seems to be no room for him, let us suggest that he look beyond the places where he must actually make use of the theoretical formulae he has mastered; and to the man engaged in a technical pursuit, who has long since gotten into a rut which is becoming deeper and deeper, the engineer who is fussing and fuming and worrying his life away because he is on the wrong road, let us advise that he risk the shock of pulling himself out of what, for him, is not the proper environment and of turning into any of the roads which point to success in the business world. If he knows how to be a man among men, let him take up sales engineering.

Macadam Roads Resurfaced With Vitrified Shale Cubes

MACADAM roads may be resurfaced in such a way as to meet the requirements of high-speed motor traffic by the use of cubes made of vitrified shale similar to that used for the manufacture of vitrified brick paving blocks. Such a construction has been found satisfactory in Monroe County, New York State. The methods in use are described herewith by J. Y. McClintock, county superintendent:

Besides being used for resurfacing old water-bound macadam roads after shaping them up with local gravel, the cubes have been used for resurfacing old tar penetration macadam roads shaped up with a thin layer of sand. The cubes have also been laid on new gravel foundations, on broken stone foundations filled with sand, on sand cushions on concrete bridge floors, and on sand cushions on broken furnace slag foundations.

Manufacture of Cubes

The cubes are made in an ordinary screw brick machine having wire grill inserted in outlet of cylinder. After being dried in an ordinary dry kiln, the cubes are burned in a down-draught kiln about 70 ft. long and 20 ft. wide, divided into two parts by a flue running through the centre The cubes are shoveled into this kiln with no more care than would be taken with broken stone. By properly manipulating the dampers it is possible to burn the cubes very uniformly, and it is also a very simple matter to cull the cubes by color. After burning, the cubes absorb about 3 per cent. of their weight of water.

The usual practice in resurfacing with cubes is to make the surface paved with them of a somewhat less width than the supporting base. Broken stone or coarse gravel shoulders are then built out from the edges of the cube pavement to the edges of the base. This permits traffic to pass from the paved area to the earth shoulders with less tendency to break down the pavement at the edges. The cubes weigh about one pound each, and are laid close together, about 225 being required to cover one square yard of surface. The joints between the cubes are filled with any fine local material, such as sand or loam.

Some of the best pavements of this kind have been laid by town superintendents with unskilled local labor. An especially good pavement of this kind has been built by the town superintendent of Brighton. This road is about one-quarter mile long, and consists of a 12 ft. pavement, with broken stone shoulders on a 16 ft. broken limestone base 5 in. in thickness after rolling. This road was built at a cost of $9,900 per mile, including the broken stone foundation. A gravel road one-quarter mile long was built during 1916 by the town superintendent of Irondequoit and paved for a width of 12 ft. in the centre with cubes, the shoulders being of coarse gravel. The cost of this road was $6,100 per miles, including the shaping and the gravel foundation. Another road is shaped up to a width of 28 ft. between gutters, and there is placed in the centre a foundation of local field stone, consisting of slabs of rotten sandstone thoroughly rolled to a depth of 8 in. in the centre and 4 in. at the edges. In the centre is placed a cube pavement 13½ ft. wide, with broken stone shoulders, all on a clay bottom.

Cubes at $2 Per Thousand

The cubes have been manufactured and sold for $2 per thousand, with a margin of profit. We are advised by some of the leading clay experts that it would be possible to arrange a brick yard with tunnel kilns and machine carriers so as to very materially reduce the cost of manufacture.

Our experience demonstrates that the cubes can be laid down and the joints filled at a cost of about 10 cents per square yard. Since, as previously stated, about 225 cubes are required to cover one square yard, this would bring the cost of the cube pavement, in place and filled, perhaps as low as 55 cents per square yard.

Assuming that these cubes were used on the 6,000 miles of state and county highways already built and adding say, 20 per cent. for contractor's profit, the work could be done for between $5,000 and $6,000 per mile. The pavement could also be used upon town highways not included in county systems. On these the stone foundations might be 12 ft. wide and the cube pavements 9 ft. wide. Such work could be done by town superintendents and the cost of surfacing reduced to $3,000 per mile.

The cube pavement supports traffic, has an attractive appearance, and affords a surface which is not slippery.

Mainly Constructional

East and West—From Coast to Coast

The footings for the new bridge over the Rouge River at Locust Hill, Ont., have recently been completed.

The Stratford city council have passed a by-law to raise $15,000 for various waterworks improvements and extensions.

A new firm has recently been incorporated, known as the Bond Engineering Works, Limited, with a capital stock of $100,000, head office at Toronto.

The council of St. Mary's, Ont., recently passed a by-law to raise the sum of $15,000 for the purpose of installing a small motor-driven pump in the power house.

R. R. Monk, representing the Pacific White Lead Company, of Montreal, recently visited Vancouver to make arrangements for the establishment of a lead and paint plant on the industrial island.

The city's portion of the work on the Bloor Street Viaduct, Toronto, is to be proceeded with just as soon as the contractors hand the bridge over to the city, according to the statements of civic officials.

The Dominion Railway Board have ordered the Canadian Northern Railway to file plans for the proposed subway on the Don Mills road at Donlands, Toronto. This subway is on the new cut-off line through North Toronto to the Toronto-Ottawa main line.

Superintendent Frank Pineo, recently appointed under the good roads' scheme for the County of Elgin, Ont., has already commenced operations. The work of levelling and grading the roads throughout the county will take some time, but will hardly be got under way until next spring.

The contract was recently let to the Chick Contracting Company, Windsor, for the extension of the Essex Terminal Railway from Ojibway to near Amherstburg, where the Brunner Mond Company, a subsidiary of the Solvay Process Company, is building an $8,000,000 plant. The contract price is $60,000.

Renfrew County is the latest addition to the good roads' movement in the province of Ontario. There are now only five counties which have not joined in this system. Renfrew will have 211 miles of improved highway, and this will bring Ontario's total to 7,500 miles. There are already 2,300 miles of good roads completed in the province.

A by-law will be submitted to the ratepayers of Leamington, Ont., in regard to the establishment of a large sugar plant there. The factory would be located near the lake and would cost in the neighborhood of $800,000. The promotor of the enterprise makes it requisite on the part of the town to secure contracts from growers who will produce 8,000 acres of sugar beets.

A delegation of some 400 business men of Brantford, Galt, Kitchener, and other towns on the line of the Lake Erie & Northern Railway, gathered at Port Dover recently to impress on the minds of government representatives, who were there making an examination of the harbor, the need for further work. The government has voted $6,000 for the work, but it is declared that more is required.

A suburban road commission has just been authorized for the city of Guelph. The Ontario cities which now have these commissions are Toronto, Kingston, Hamilton, St. Catharines, London, Windsor, Galt and Kitchener. The business of the commission is to improve and maintain the roads adjacent to the city. Forty per cent. of the cost is paid by the province and the city and county each pay thirty per cent.

A delegation from Cartierville and Laval County recently visited Montreal to urge upon the city council that the Lachapelle-Viau bridge, over the Back River be placed in shape for traffic. They hold the city of Montreal responsible and place the cost of repairs at about $20,000. Mr. W. Levesque, M.P.P. for Laval, declared that the people in his county wanted a new bridge capable of carrying heavy traffic and tramways, in the construction of which they would be willing to give some financial aid.

The municipal hospital idea is growing in popularity in the west. By-laws providing for the erection of such institutions will be submitted at the coming municipal elections at the following points in Saskatchewan: Lanigan, Kindersley, Stoughton, Eastend, Carnduff. It is proposed to municipalize the hospital at Rosetown and practically double its capacity. At Shaunavon, Ponteix and several other places the erection of buildings is under way, and a by-law was recently passed by the ratepayers of Benson and Browning rural municipalities and the village of Lampman to build a hospital at the latter point at a cost of $18,000.

At the recent convention of the newly-formed Good Roads League of British Columbia, at Duncan, it was decided to divide the province into ten districts, each of which will supply two members to the board of directors. Future annual meetings will be held in proximity to the Union of British Columbia Municipalities' convention. The question of a national highway from Vancouver Island to Glace Bay was foremost in the discussion. Officers were elected as follows: Reeve W. A. McKenzie, Penticton, president; Alderman Gale, Vancouver, Alderman Coburn, Nanaimo, J. Walters, M.L.A., Merritt, vice-presidents; J. S. Hales, Penticton, secretary; Mayor Dill, Enderby, treasurer.

It is reported that the C. P. R. is about to secure another outlet to the Pacific coast. This is to be brought about by the completion of the Spokane and B. C. Railway to Spokane early next year, by the construction of an additional 145 miles of road. At the present time the C. P. R. must carry the business from the coast and from Spokane to the Boundary over the connection by way of Kingsgate and the Kootenay Lake, encountering heavy grades, but the new connection will make transport possible from the Boundary and the West Kootenay direct to Spokane and the coast by an all-rail route on easy grades. Construction work will proceed this year, according to the statement of Mr. E. McPhillips, of Toronto, vice-president of the Spokane & B. C. road.

Competitive plans have been received by the Board of Education of Barrie, Ont., for a new Collegiate building, which is to be erected if the ratepayers vote in favor of it. Two plans were settled upon from which a choice is to be made. One, submitted by Ellis and Ellis, of Toronto, provides for an entirely new building, and another, prepared by Mr. W. W. LaChance, covers the reconstruction of the old building. As the architects were unwilling to go ahead with the preparation of working drawings and specifications necessary for calling definite tenders, without assurance that their plans would be accepted, the board decided to pay the unsuccessful architect $1,000, and instructed both to go ahead. In this way complete details will be available of both plans and the cost will be available when the proposition is submitted to the ratepayers. Present estimates place the new building at $82,000, and the reconstruction plan at $80,000.

Representatives numbering nearly one hundred, from all towns and cities between Hamilton and Owen Sound, recently met at Guelph and formed an organization to be known as "The Hamilton-Guelph-Owen Sound Good Roads Association." It has for its object the construction of a provincial highway from Hamilton to Owen Sound by way of Guelph, Fergus, Mount Forest, Durham, and other points, along the lines laid down by the Ontario Legislature at its last session. Mr. W. A. McLean, Deputy Minister of Highways for Ontario, addressed the delegates, giving them much encouragement. The following officers were elected: President, G. B. Ryan, Guelph; first vice-president, Wm. Gaskill, Hamilton; second vice-president, C. K. McGregor, Fergus; secretary-treasurer, T. J. Hannigan, Guelph; executive committee, J. N. Scott, Mount Forest; E. Lemon, Owen Sound; J. Calder, Durham; H. J. Colwell, Arthur; James McKay, Hamilton.

Personals

Mr. H. Rolph has been appointed president of the John S. Metcalf Company, Limited, Montreal, grain elevator designers.

Major H. Lefebvre, Jr. C.S.C.E., Montreal, has been awarded the Military Cross. He went overseas with the first contingent, and was later attached as a lieutenant to the 10th Canadians, with which he went to France. Major Lefebvre has been twice promoted for conspicuous bravery.

Obituary

Mr. Fred Dunker, a carpenter and contractor, of Kitchener, Ont., was instantly killed when an automobile in which he was driving capsized near Oakville. The deceased was only 25 years of age.

Mr. Wm. Wood, who for forty years has carried on a contracting business in Toronto, died recently after a few days' illness. The late Mr. Wood was born in Plymouth, England, and came to Canada when he was twenty years of age, settling in Toronto.

Mr. Ernest Belanger, M.C.S.C.E., of the firm of Marion & Marion, died at his residence in Montreal on October 20, aged 53. Death was due to complications following an accident in which he broke his leg. Mr. Belanger was a graduate of the Polytechnic School, of which he was a director for eight years. He was a member of the Quebec Streams Commission, director of the Alliance Francaise, and an officer of the French Academy. He was also a director of the Elder Ebano Asphalt Company. In 1911 he was a member of a Royal Commission appointed to visit the chief European countries to study technical education. The body was taken to Ottawa for burial.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Arnprior, Ont.
Town Council contemplate the construction of tarvia macadam roads. Clerk, T. H. Grout.

Bienville, Que.
Tenders will be called for turbine pump for waterworks for the Municipal Council. Engineer, C. Lessard, 193½ St. Valier Street.

Chatham Township, Ont.
Tenders will be called about November 20 for drainage and dredging work costing $20,000 for the Township Council. Engineer, W. G. McGeorge, 153 Queen Street, Chatham.

Sault Ste. Marie, Ont.
The Water Commission, City Council, contemplate the erection of a pump house, etc. Manager, Mr. Van Every.

Strathroy, Ont.
Town Council want tenders for pump house and turbine pump for reservoir, pump house, etc., costing $10,000. Engineers, Kerry & Chace, Confederation Life Bldg., Toronto.

CONTRACTS AWARDED

Port Arthur, Ont.
The Canada Iron Corporation Ltd., Montreal Street, Fort William, have the pipe contract for watermain for the Public Utilities Commission. Engineer, L. M. Jones.

Railroads, Bridges and Wharves

Galt, Ont.
The Canadian Pacific Railway, head office, Montreal, contemplate the construction of a double track line from here to Guelph. Engineer, Mr. Sillman, C. P. R. Office, London.

Regina, Sask.
City Council contemplate the erection of a public station and street railway depot costing $15,000 at the corner of Hamilton Street and 11th Ave. Commissioner, L. A. Thornton.

Vancouver, B.C.
The Northern Construction Co., Ltd., 606 Union Bank Bldg., Winnipeg, general contractors for $1,000,000 depot for the Canadian Northern Railway, are receiving tenders for 200 tons of reinforcing steel.

CONTRACTS AWARDED

Galt, Ont.
The Sherwood Construction Co., Ltd., Mail Bldg., Toronto, have the general contract for a $20,000 steel and concrete bridge for the Canadian Pacific Railway, head office, Montreal, Que. ... ...

Thornburn, N.S.
J. W. Douglas, New Glasgow, has the general contract, is in the market for a quantity of material and lets plumbing, painting, heating and electrical work for station and engine house for the Canadian Government Railway, Moncton.

Public Buildings, Churches and Schools

Ashcroft, B.C.
Edward Hunt, Victoria, has the general contract for addition to public building for the Department of Public Works, Dominion Government.

Barrie, Ont.
Tenders are being received until November 20 for the erection of an $80,000 two-storey brick collegiate institute for the Board of Education. Plans at office of the Secretary, Fred Marr and architects, Ellis & Ellis, Manning Chambers, Toronto.

Calgary, Alta.
The Hospital Board contemplate the erection of a $15,000 two-storey brick nurses' home. Architects, Lawson & Fordyce, care of owners.

Tenders will be called shortly for the erection of a stone and brick post office for the Department of Public Works, Dominion Government. Chief architect, E. L. Horwood, Robinson Bldg., Ottawa.

Coronation, Alta.
Plans and specifications are with the secretary-treasurer, Henry Thompson, who will receive tenders until November 10 for the erection of a frame school for the Board of Trustees, School District No. 2926.

Dartmouth, N.S.
School Board contemplate the erection of a $20,000 addition to "Victoria" school. Secretary-treasurer, A. Elliott, Pleasant Street.

Duncan, B.C.
The Provincial Order of the King's Daughters contemplate the erection of a hospital addition.

East End, Sask.
The Village Council contemplate the erection of a hospital. Secretary-treasurer, A. H. Stevens.

Fort William, Ont.
The English Church contemplate the erection of a one-storey frame club room on Edward Street. Rev. Bruce is pastor.

Hamilton, Ont.
Tenders are being received by the clerk, S. H. Kent, addressed to the Mayor, Chas. G. Booker, until 5 p.m., November 5, for alterations and additions to Maternity Building, City Hospital. Plans and specifications with the architects, Stewart & Witton, Provident & Loan Chamber, Hughson St. S.

Kamloops, B.C.
The Limit School District contemplate the erection of a school. Address, Public Works Engineer, A. E. Foreman, Parliament Bldgs., Victoria.

Kindersley, Sask.
The Town Council contemplate the erection of a hospital. Clerk, H. R. Dyer.

Lampman, Sask.
The Municipalities of Benson and Browning contemplate the erection of an $18,000 union hospital. Clerk of Lampman, H. D. Buller.

Lanigan, Sask.
The Town Council contemplate the erection of a hospital. Clerk, W. L. Craddock.

Nanton, Alta.
The Nanton School District and Parkland School District have under consideration the erection of a school.

Rosetown, Sask.
The Town of Rosetown and District contemplate the erection of a hospital addition. Clerk of Rosetown, J. W. Heartwell.

Stoughton, Sask.
The Municipalities of Tecumseh, Golden West and Villages of Heward, Forget and Stoughton contemplate the erection of an $18,000 union hospital.

Toronto, Ont.
Tenders are wanted on all trades for the erection of a church building for the Spiritualist Church Congregation, care of Mr. J. T. Stier, 124 Hallam St.

Vancouver, B.C.
Tenders will be called for remodelling hospital at a cost of $4,000 for the Vancouver General Hospital Board. Architect, J. A. Benzie, 37th St. W.

Winona, Ont.
The Royal Flying Corps, 56 Church St., Toronto, contemplate the erection of an aerodrome, including hangars, waterworks, lighting system, sewage system and concrete roadways costing $500,000. Architect and engineer, J. B. Carswell, 56 Church St., Toronto.

CONTRACTS AWARDED

Brantford, Ont.
The Brampton Hardware Company have the heating and plumbing contracts for $60,000 school for the High School Board. The general contractor, M. C. Sackrider, Brampton, is in the market for a quantity of brick, cement, artificial stone, pitch roofing and two electric motors.

Byron, Ont.
John Hayman & Sons, 432 Wellington St., London, have the general contract for $10,000 vocational school for the Government Hospital Commission.

Charlottetown, P.E.I.
E. E. Parkman & Son, 13 Euston St.,

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Principal Contents

Buy a Bond!

THERE are many reasons why every reader of the Contract Record should subscribe for the forthcoming government loan, and use his influence that others may do the same. Loyalty and duty hold a prominent place; also the desire for a profitable investment; also the unsurpassed security behind it. But all these aside, the unanswerable argument still remains that the success of the loan means a continuance of "good business."

Suppose, for example, you have a sum of money, say $1,000, saved from your business, which you intend to set aside as a reserve in some interest-bearing investment. You may buy a bank stock, a bond issue of some city or town anywhere in Canada, a railway, telephone, telegraph, or public utility stock. You do not know, or question where the principal goes; you ask only that the dividend be secure.

Suppose, in contrast to this, that a client or corporation of unquestioned wealth and dependability came to you and offered to borrow your $1,000, pay the same rate of interest, and in addition turn round immediately and spend the whole amount in your business so that you would also reap your usual business profit. What a very much better proposition it would be! The attractiveness of such an investment, to you, would be perhaps twice as great as the bank stock or the municipal bond.

Now this, in effect, is what the Canadian Government promises to do. The money is not to be used on some big Dominion work that profits only a few, but is to be spent for supplies—raw and manufactured—taken from all over Canada—country and city and town alike. And as all true Canadians are engaged in "supplying" something, practically every man, woman, and child profits as the money becomes gradually redistributed.

Thus a subscription to the coming loan is a business proposition of the most attractive kind. Anyone who profits by "good business" in Canada—and who does not?—will be considering his own interests twice over when he invests in a bond—first, in the excellent interest return, and, second, in the trading profit from so much extra turnover.

Saskatchewan Engineers at the Service of the Government

MEMBERS of the Canadian Society of Civil Engineers in the other provinces will be interested in the recent action of the Saskatchewan branch, as indicated in the following resolution presented on Oct. 29 to Premier Martin. The committee presenting the resolution consisted of Chairman L. A. Thornton, Past Chairman O. W. Smith, and Secretary-Treasurer J. N. de Stein:

To the Executive Council of the Government of the Province of Saskatchewan:

Honorable Gentlemen,—This petition is presented by the Saskatchewan Branch of the Canadian Society of Civil Engineers, which includes all members of the society residing in our province.

The Canadian Society of Civil Engineers, founded by royal charter over thirty years ago, has now a membership of over three thousand, amongst whom are some of the most prominent men in the scientific, industrial, and technical world of our Dominion. The educational requirements and the years of experience necessary for qualification to the various grades of membership are the most stringent, ensuring utmost efficiency of all members in the particular branch of their profession.

The provinces of Quebec and Manitoba passed legislation in our favor some considerable time ago, restricting the term "civil engineer" and the practice of our profession within those provinces to members of our society, and at present a legislative committee of our parent society at Montreal has been nominated to draw up suitable proposals to be submitted for legislation in our Dominion.

Our profession, in its manifold branches, does not only form an essential, creative factor in our life, carrying and aiding civilization, providing it with its necessities, enabling communications, manufacturing, etc., but the present titanic world-struggle might properly be termed a "war of engineers." Mechanical, structural, nautical, and the various other branches of engineering are feverishly exercising and straining their inventive, and constructive faculties for a supremacy in the three elements—air, land, and water.

In Great Britain and the United States the large engineering societies are always consulted before any extensive works are undertaken, and we dare say that considerable waste of public monies in our various provinces could have been prevented if a similar course of action would have been taken.

We beg to put our services at the disposition of the government of this province, and hope to be able to co-operate to the fullest extent when called upon.

We would consider it a favor to be consulted in any new legislation touching upon our activities, and would be glad to give any information at our disposal, either as a "consulting body" or in an advisory capacity concerning qualifications of members of our profession.

In conclusion, we beg to state that a similar movement in the Province of British Columbia has been promised the most earnest consideration on behalf of the Executive Council of that province.

This petition respectfully presented by a committee of the Saskatchewan Branch, Canadian Society of Civil Engineers.

Reasons Why Every Canadian Should Buy a Government Bond

1. It is a patriotic duty.
2. It is an excellent investment, yielding probably over 5½ per cent.
3. It is an absolutely safe investment.
4. It is free from war taxes—which are piling up.
5. You can always borrow on it up to practically the face value.
6. It is always saleable at a moment's notice.
7. The proceeds of the loan will be re-distributed in Canada—immediately. This means that every workman, every retailer, every dealer and jobber, every manufacturer, every supplier of raw materials, will get his money back through the usual business channels.

Opportunity for Manufacturers of Contracting Equipment

THE following is a report by the U. S. Consul in Edinburgh, Scotland, published in U. S. Commerce Reports. This is an opportunity which might be taken advantage of by Canadian manufacturers of construction plant and materials who are looking forward to export trade at the close of the war:—

"Notwithstanding taxation will rest heavily upon every community in consequence of war expenditures, soon after the return of peace large projects must be undertaken in this part of Scotland. Streets and highways have been badly worn by increased traffic and repairs have been deferred; harbor construction and improvements, for which full arrangements were made several years ago, are in abeyance owing to financial and labor problems; and tramway extensions, important housing schemes, sewerage works, industrial plants, land-clearing and drainage enterprises, and the development of mines and quarries are among the other works, public and private, which must receive attention when conditions will permit.

American manufacturers and exporters of machines for engineers and contractors in the various lines indicated could probably cover this market in the most satisfactory way from general agencies in English commercial and industrial centers to which the engineering and building concerns throughout the country are in the habit of sending orders for heavy machines of all kinds."

New Members of C. S. C. E.

The following have been elected members, associates, juniors, etc., of the Canadian Society of Civil Engineers:

Member—Mr. E. V. Caton, chief engineer, city of Winnipeg, light and power department.

Associate members—Mr. J. A. Buteau, professor at Ecole Technique, Quebec, lecturing on mechanics, mathematics, steam boilers, engines, and turbines, refrigeration, etc.; Mr. R. B. Chandler, Port Arthur, resident engineer of C. D. Howe, Regina, in charge of construction of hospital, elevator for Grain Growers' Grain Company, Ltd., and terminal elevator for Saskatchewan Co-operative Elevator Company, Ltd., Port Arthur, Ont.; Mr. P. R. Genders, Regina, assistant, surveys branch, Land Titles Office, Saskatchewan; Mr. J. J. Hanna, lieutenant Third Tunnelling Company, Canadian Engineers, France, and prior to that assistant, roadways department, city engineer's staff, Calgary; Mr. L. J. M. Howard, Ottawa, engaged in valuation work for Imperial Munitions Board; Mr. H. C. Mann, of Duncan, B.C., assistant to district engineer, Department of Public Works, Victoria; Mr. F. H. P. Parr, Winnipeg, on staff of Kelvin Technical High School, Winnipeg; Mr. G. H. Patrick, Strathmore, Alta., senior canal superintendent in charge of main canal and two secondary canals, Division of Irrigation Branch, Department of Natural Resources, C.P.R.; Mr. H. E. Stevens, Courtenay, B.C., assistant to district engineer, Provincial Public Works Department, British Columbia; Mr. S. Young, Regina, surveyor and engineer for Department of Highways, Province of Saskatchewan.

Junior—Mr. H. E. Randall, Jr., Montreal, in charge of sales department in engineering capacity of Shawinigan Water and Power Company.

Transferred from associate to member—Mr. F. W. Alexander, Calgary, division engineer, C.P.R., Calgary.

Transferred from junior to associate—Mr. D. H. McDonald, Antigonish, N.S., in charge of hydrographic and land surveys, carrying out harbor improvements, Public Works Department, Canada; Mr. E. H. Pacy, Montreal, on staff of board of engineers, Quebec Bridge.

Transferred from student to associate—Mr. Le Roy Brown, Sault Ste. Marie; Mr. J. H. Irvine, lieutenant Fifteenth Canadian Reserve Battalion, on active service; prior to that draftsman, Hudson Bay Railway; Mr. A. D. Ferguson, Winnipeg, draftsman and assistant to divisional engineer, Hudson Bay Railway, The Pas, Man.

It is officially announced that the Canadian troops serving on the western front include, in the engineers, twelve field companies, one base company, three tunnelling companies, two railway operating companies (one broad gauge and one light gauge), one railway construction corps, and one construction company.

Manufacture of Pre-cast Deck Slabs for C.P.R. North Toronto Bridges

Sixty-six T-Beam Units, Weighing Fifty-two Tons Apiece, Will be Set in Place on Concrete Trestle Towers to Make Deck

ONE of the unusual features of the two new concrete bridges at present in course of construction on the Leaside-North Toronto line of the Canadian Pacific Railway, is the deck which is to be built of pre-cast T-slabs. An article in the Contract Record of August 22, page 711, described these two bridges as reinforced-concrete trestle structures having four-post bents paired into towers. One of the illustrations of the article referred to showed the plan, elevation, and section of one of these bridges. The decks are to be of reinforced concrete T-girders,

These girders will compose the deck of the concrete trestle bridges on the Leaside-North Toronto C.P.R. line.

which are being manufactured in individual units to be set in place on the towers after the latter have been poured. The two bridges are identical in design, except that one is a three-track structure, while the other will accommodate only two tracks. As this type of deck construction is of rather unusual character, the following article descriptive of the manufacture of the T-beams will be of interest. The details will apply to the three-track bridge over the Reservoir Ravine, on which Wells & Gray, Ltd., of Toronto, are the contractors.

Girders Manufactured Beforehand

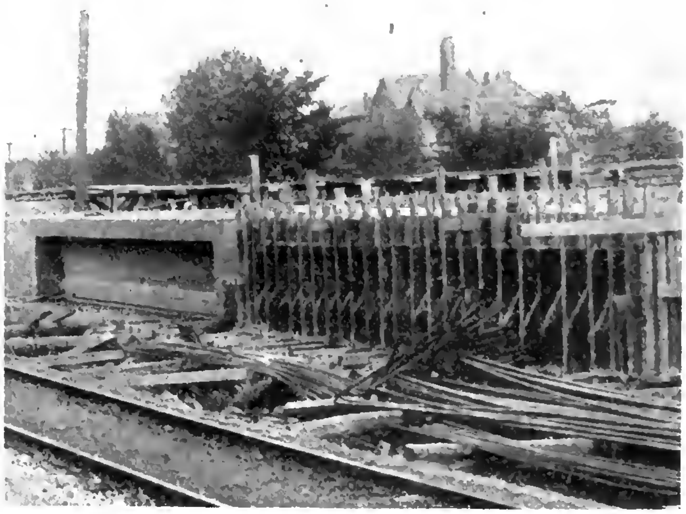
On account of being able to manufacture the deck slabs before they are required, the contractors have been able to keep an organization at work without being delayed pending the demolition of the old steel bridge. The new structure will occupy the place of the existing bridge and although some of the footings were poured before its destruction, rapid progress was greatly hampered until the old steel was removed. The manufacture of the T-beams was, however, proceeded with, shortly after the contractors located at the site. By so doing, these will be ready and completely cured when the towers are finished.

On the three-track bridge there are 66 slabs in the deck, there being 11 panels of 6 beams each. The tower spans are 34 feet and the spans between the towers are 36 feet, 36 beams of 36 ft. span and 30 beams of 34 ft. span being used. The outside beams in each case are special, being provided with lugs to carry the sidewalks which are to be of smaller T-beams.

Yard for Manufacture of Beams

The contractors have established a yard for the pouring of the slabs, located on the right-of-way alongside the track, just east of the bridge site. At this point, the mixer and storage piles are located, the forms are set up, pouring is done and the completed beams are allowed to cure. The yard was carefully graded to firm ground to provide a suitable working foundation. No packed or backfilled soil was used. The total length of graded ground is about 1,200 feet, the width being 30 to 50 feet. About 900 feet of this yard is occupied by beams. In the graded soil, 8-inch ties or timbers are set and solidly bedded with wooden mauls. These are at 16 to 18-inch centres. On them, 4 x 4 stringers are set, and carefully levelled to receive the forms. Two rows of beams are set up the entire length of the yard.

One of the illustrations herewith shows the details of the form work. The bottoms of the boxes are composed of tongue and groove sheeting resting directly on the stringers. The sides, ends and flanges are formed separately with tongue and groove sheeting. Brackets of the design shown, made of 2 x 4's, hold the sides in place. In setting up the box, it is entirely formed with the exception of one end, which is left open to receive the reinforcement. In stripping the ends are taken down and the brackets are removed after knocking out the wedges, thus allowing the sides

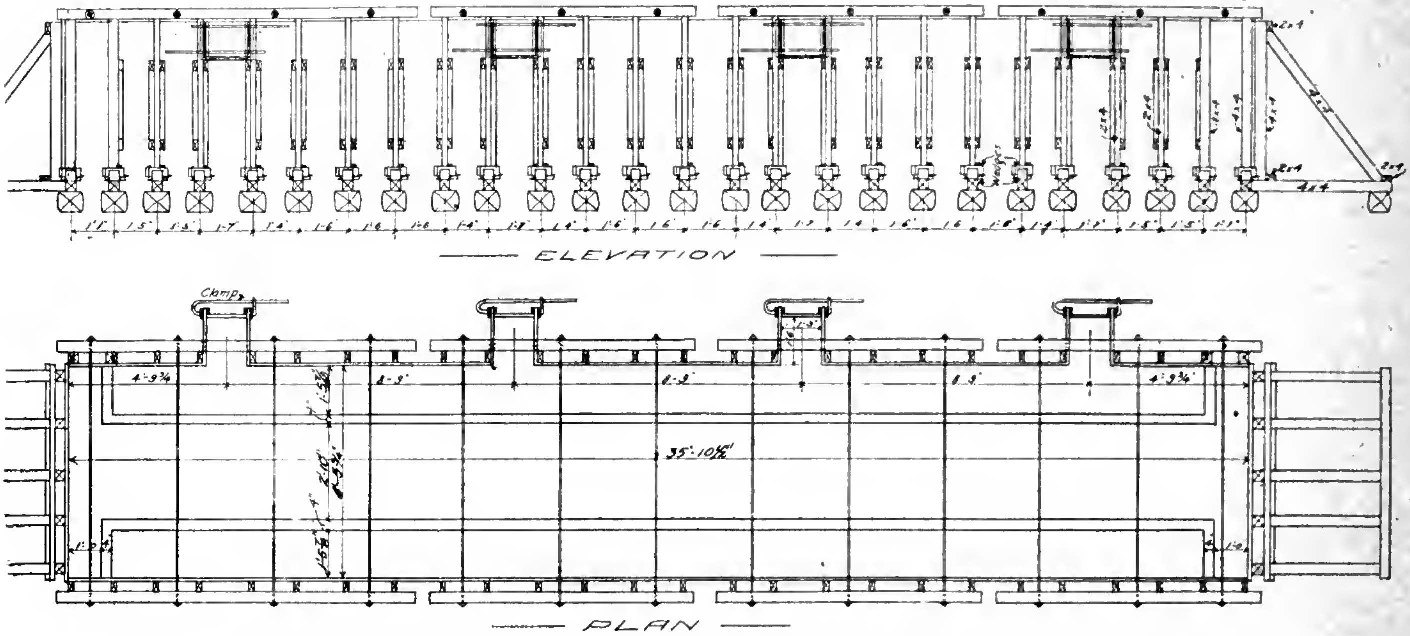


On the right, the forming for a deck slab. On the left, a slab stripped. Pouring is performed from buggies operating on the runway.

to be taken apart. Twelve sets of forms have been provided.

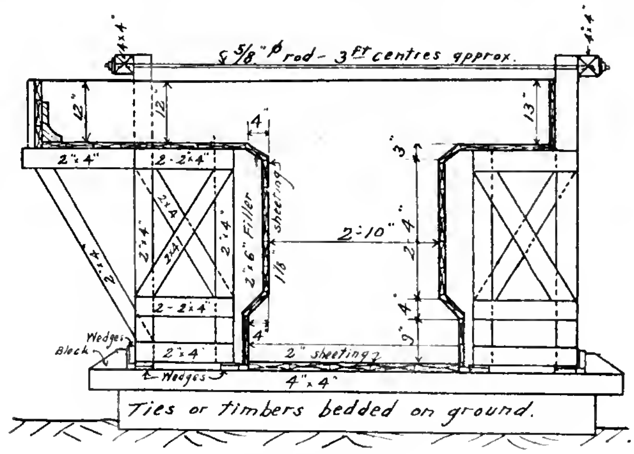
Weigh 52 Tons

The mixer, located at about the centre of the yard, is a portable ½-yard batch mixer of the London No. 3 type, equipped with power loader. The sand and crushed stone are kept in open piles alongside the track while the cement is stored under cover. The concrete is buggied to the forms along an elevated longitudinal runway, running the entire length of the yard. Short



Detail of formwork. Plan and elevation of 36 ft box.

transverse runways are placed so as to reach the boxes. Each beam contains 23 to 24 cubic yards and under normal operation two beams are poured per day. If sufficient forms were available, four beams could be produced, since the mixer has a daily capacity of about 100 yards. With the dozen sets of forms on hand, however, two beams are a normal day's output, allowing for sufficient time to set up boxes and strip poured beams. The weight of each beam is 51 to 52 tons.



Section of box.

On November 1, forty beams had been completed, leaving 26 to pour before the output is complete.

Reinforcement Details

The reinforcement of the deck slabs is fairly complicated. Steel is provided to take both compression and tension. The main reinforcing comprises bottom bent rods and trussed rods with two set of stirrups, and longitudinal and transverse ties in bottom and top of flange slab. In setting the bars, the box is set up with one end removed. The bottom stirrups are placed and tied, then the main stirrups, then the bent rods and the trussed rods, one by one. The flange rods are finally placed and the whole securely tied. Small concrete blocks are used upon which to rest the steel. The rods are plain rounds. Four men can set up one box and place the reinforcement in one day. Some of the bending is done on the job.

The blocks are allowed to dry for two weeks to one month before the forms are stripped. After removal the forms are again assembled at another part of the yard ready for pouring. The wastage in lumber is very low, since the repairs to forms are merely minor replacements of boards broken during stripping. A carpenter shop on the job makes all form work. In stripping, the wales and tie rods are removed, and the brackets are withdrawn after knocking out the wedges, after which the sides collapse.

In addition to the deck slabs, this plant is used to manufacture the sidewalk slabs, which are smaller broad-flanged T-beams spanning between the projections on the outside blocks. Coping or curb blocks are also manufactured. They form a curb at the inner edge of the sidewalk. Concrete posts are being made for the hand-railing. The rails will be old 2-inch boiler tubes.

Lifted by Crane

When the bridge towers are completed, the blocks will be lifted by locomotive crane and set in position across the bent-caps. For handling them, two 12-inch I-beams back to back are placed on top of the slabs at each end. These are fastened by heavy rods to a bottom plate. The crane will lift on the two sets of I-beams. In placing, drainage is provided at the centre of each pair by having the top surfaces slope to scuppers. The beams will be grouted and waterproofed and the track laid in ballast.

The bridge has been designed by the C. P. R. bridge department, of which P. B. Motley is engineer. Mr. Barber is division engineer of the C. P. R., and superintending the work.

The contract for the construction of the military hospital at Ste. Anne de Bellevue has been awarded to E. G. M. Cape & Co., Ltd., Montreal. The buildings comprise several units, and are regarded as of a temporary character. The construction is concrete and brick, with a very large amount of frame work. The Military Hospitals Commission, Ottawa, who awarded the contract, for which there was keen competition, have a large amount of similar work on hand, including hospitals in Westminster Township, Ont.; Fredericton, N.B., and Charlottetown, P.E.I.

War Has Effect on Garbage Production and Disposal

According to I. S. Osborn, head of the Division of Food and Household Wastes, United States Food Administration, the effect of the war on the production and disposal of garbage has become very apparent during the past nine months. At the meeting of the American Public Health Association he stated that the question is a vital one at the present time. The education of the public in food conservation is tending to change the problem of garbage disposal. What the ultimate result will be is uncertain, as we are just beginning to realize that a great change, which no doubt will revolutionize this branch of sanitary engineering, is taking place.

Returns to the Food Administration show that in 60 cities there was an average decrease of from 12 to 15 per cent. in garbage collection in the first nine months of this year, although in some cities an increase over previous years is shown. Some of the decrease is due to less thorough public collection and some to more extensive private collection for pig feeding or for reduction. The decrease would have been considerably greater, it is believed, except for the large amount of vegetable waste going into the garbage pail from home gardens.

Grease Content Reduced

The amount of grease recovered from garbage is a better indicator of saving than the quantity of garbage collected. The actual percentage of grease per ton of garbage shows a reduction of approximately 15 per cent. No doubt there has been a greater reduction in the consumption of meats than is indicated by the decrease in the amount of grease recovered from garbage. At virtually every meat market, scraps, gristle, rind, and bone, which were formerly trimmed off and sold to rendering companies, are now pushed off on the purchaser at the price of edible meat. Evidence of this is found in the reduced amount of scraps purchased by rendering companies.

The current methods of garbage disposal are burial, dumping, incineration, feeding, and reduction. Burial and dumping are carried on at low cost, but they produce no revenue, and unless proper attention is given to them they are likely to create a nuisance.

Until recently there has been a strong tendency toward incineration, especially among the smaller cities. This method, in nearly every case, has been followed at considerable expense to the municipalities, both for installation and operation, with no returns except in the very few cases where power has been developed, but in most instances the cost of power development has been greater than the revenue obtained.

There is now a strong tendency to adopt some method of garbage utilization instead of incineration. Garbage piggeries will be found desirable in many cities. Each thousand population produces food wastes sufficient to feed 25 hogs for market. At the present price, a ton of garbage will produce from $7 to $8 worth of pork. In the smaller communities, no other method of garbage disposal will show returns as desirable from an economic viewpoint as feeding garbage to pigs.

Increased Value Offsets Decreased Quantity

For the larger cities, no doubt garbage reduction will prove to be the most advantageous method. The decrease in quantities of by-products will to a large extent be offset by their increased values, and at the same time there will be a tendency to recover additional by-products that now are lost.

There is an ever-increasing demand for the tankage produced from garbage, for use in the manufacture of fertilizer. The price of nitrogenous fertilizer is determined by the available nitrogen. The old form of tests showed a low available nitrogen in garbage tankage, but the soil tests now made by the United States Department of Agriculture show that the material decomposes readily, affording a rapidly available nitrogen supply.

The values of the by-products from the existing garbage reduction plants, at present prices, will amount to $8,500,000 for grease and $2,250,000 for tankage. From the tankage can be produced annually about 9,000,000 pounds of nitrogen, 25,000,000 pounds of bone phosphate lime, and 2,500,000 pounds of potash. The grease that is recovered is split up into various by-products, the glycerine content being the most valuable. From the garbage grease produced in the plants operating in the United States, 8,000,000 pounds of nitro-glycerine can be extracted, and still leave grease from which can be made approximately 200,000,000 twelve-ounce cakes of soap.

There is a great shortage of the materials that can be produced from garbage. Utilization is not solely a question of profit. Every community should utilize its wastes and make available from this source everything which may be gained thereby for the country's needs.

The food problem will not end with the war. The shortage of fats and fertilizer will continue for years. The installation of proper methods of garbage utilization will be not only a present help, but also a benefit in future years. The public will not forget soon its present lessons in economy. Never again will it waste so much through the garbage can as it has wasted in the past.

New Fire Escape Design Prevents Congestion

There is being installed in many schools a type of fire escape construction which possesses all the elements of safety in cases where large numbers of pupils are to pass out simultaneously from different floors at the same side of the building. The structure is in the nature of an outside iron fire tower, with circling spiral stairways constructed of steel angles supported on cement foundations.

The pupils emerging from the fourth floor enter the tower and descend by means of interior stairs. The third floor pupils descend by means of a stairway circling the tower on the outside, and the second floor pupils also descend by another outside stairway, circling the tower, and paralleling the stairway, carrying the third floor pupils. Upon reaching the ground the pupils from the different floors exit and escape from different angles.

From the standpoint of economy this structure serves the purpose of practically three stairways, which would be necessary to relieve properly such a building. The additional cost of the material which would be strong enough to carry the three sets of stairways is slight compared to the cost of furnishing three separate sets of supports for three independent stairways.

It is impossible in a great many cases, on account of the arrangement of the rooms, to exit from the several floors at different sides of the building. Usually a stairway is at one side of the building, and in order to provide two separate means of egress from all floors, the fire-escape should be located at the side of the building opposite the interior stairway, in which case the exit from all floors to the fire-escape is the same side of the building, therefore making it obligatory for the pupils of all floors to pass down the same stairway. The idea of this new type is to prevent the congestion and crowding at the different floors.

Solution of Unusual Problem in Erosion

Unique Methods of Saving Bridge Abutments at Dundas, Ont.—Apron Wall and Groin Solve Difficulty Effectively and Cheaply

By E. H. Darling, M.E.*

THE Ewart dam in the town of Dundas, Ont., which is the property of the town, was an ancient source of water and power for several industries, but for several years it has not been depended upon to any great extent. When it finally failed it was decided to abandon it altogether.

The old mill pond, the water in which had stood at an elevation of about fifteen feet from the creek bed below the dam, was nearly filled with silt. Its banks and bed are composed of soft blue clay, mixed with sand and gravel—glacial drift from the morain of a glacier which once came down the Dundas Valley, or the silt deposited in the bay which at one time existed at the western end of the prehistoric Lake Iroquois. Left to itself, the creek began to cut a channel in this soft material at a very rapid rate.

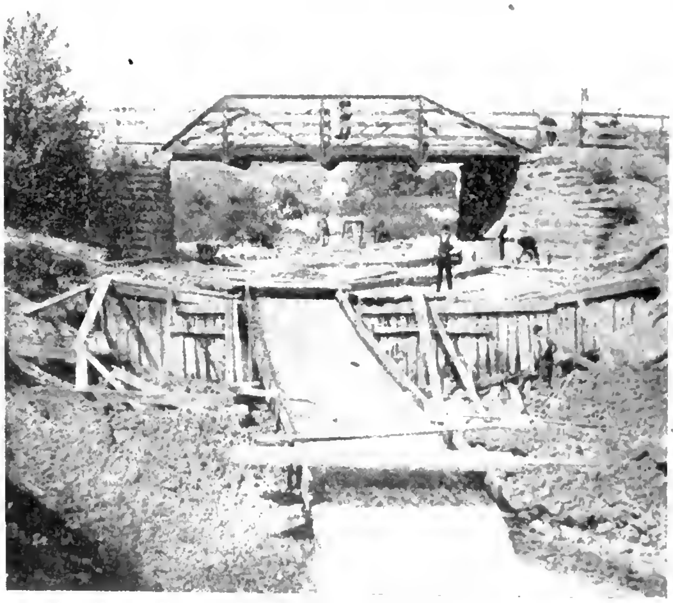


Fig. 1—Crichton Road bridge, showing washout and contractor's chute.

Bridge Abutments Threatened

About 400 yards above the dam, and at the point where the creek enters the old pond, is a steel highway bridge, known as the Crichton Road bridge, about 40 feet in span, and carried on stone abutments. To protect the foundation of these abutments the creek bed had at one time been paved with a concrete slab, and at the down-stream toe of this slab was driven a row of wood piles about eight feet long. In a very short time after the failure of the old dam the creek had so eroded its bed that it left these piles exposed, forming a cascade at this point, which threatened to undermine and wreck the bridge abutments (Fig. 1).

* Consulting Engineer, Hamilton, Ont

It would not have been a difficult matter to have provided temporary protection for the abutments, but outside of rebuilding the old dam, no scheme was likely to prove satisfactory in the long run unless there was taken into consideration the probability that the creek would continue to erode its channel until it had brought it down to about the level of its bed below the dam. The method adopted was the one which nature employs under such conditions, and which may be studied along almost any little watercourse. This was to form an artificial pool or series of pools to break the fall of the water and reduce the velocity of the current. The old wooden piles were replaced by a concrete apron having an 18 inch cut-off wall under the toe, extending to a depth of 10 feet. About 25 feet from this, down stream, another concrete wall or groin was built 8 feet deep and running well back into the banks. Both apron and groin were made lower in the centre than the sides, so as to keep the stream in the centre of the channel.

The apron wall was reinforced with ⅞ in. round rods and the groin with ⅝ in. rods on both sides. On the up-stream sides the vertical rods were spaced at 1 foot centres and the horizontal rods at 2 feet centres. On the down-stream side the vertical rods were spaced at 2 feet centres and the horizontal rods at 1 foot centres. By this means any tension stresses in the walls were taken care of, with the walls acting either as vertical cantilevers or horizontal beams. The apron was also well anchored back to the existing concrete slab. As the material under the slab was porous, drain openings were left in the apron wall to relieve any hydrostatic pressure.

Fig. 2—Protection work after a year of service.

Alternative designs were worked out, using sheet steel piling, but the cost of this construction exceeded that of reinforced concrete by 25 or 30 per cent.

Effective Results at Low Cost

After a year's trial the results have fully justified all expectations (Fig. 2). The groin maintains the pool at a constant level, while the depth has naturally adjusted itself to break the fall of the cascade. A smaller pool is forming below the groin, and, as occasion demands, other groin walls may be placed at intervals down the creek.

The entire cost of this work was less than two thousand dollars, which is only a fraction of what it would have cost to properly underpin the bridge abutments in the usual way. Besides, the creek bed above the bridge is now maintained undisturbed.

The contractors for the work were McAllister & Taylor, of Hamilton. It was carried out during the period of minimum flow of the creek, and their method of handling the water by means of a chute is shown in Fig. 1.

The work was under the direction of the Board of Works of the town of Dundas, Mr. John Douglas, chairman, and Mr. Charles E. Dickson, mayor.

Using Locomotive Cranes as Derricks

LOCOMOTIVE cranes are essentially simple derricks primarily intended to raise and lower heavy objects and shift their position transversely. They are equipped with hoisting tackles of various speed and capacity that are operated from booms revolving in horizontal circles of different radii, and are thus equivalent to ordinary stiffleg derricks.

Being mounted on locomotive platforms they are easily and rapidly moved a considerable distance from place to place much more conveniently and cheaply than an ordinary stiffleg derrick with wide, clumsy platform occupying a large space, requiring great clearance, and needing either a special broad-gauge track or two parallel narrow tracks.

Typical Features

Locomotive cranes are thus able to command a wide area for derrick service so that one machine working continuously in a comparatively large territory develops 100 per cent. efficiency and economy, and may often fully replace a considerable number of fixed derricks with their hoisting apparatus and operating crews that in intermittent service may accomplish no more work in a given time than the single locomotive crane.

Besides being able to handle loads within its capacity over a maximum radius at each of many fixed points, the locomotive crane has the very valuable ability to transport its load wherever tracks are installed for its use, and when mounted on standard-gauge trucks can operate over an unlimited length of any ordinary railroad, car line, or service track. If fitted with flangeless wheels it can run on any smooth surface without a track, and, with a caterpillar tractor, it could easily be made to float on soft, wet ground, where its light weight can be evenly distributed, and where the construction of any kind of a track road would be slow and costly. Besides these two principal operations of lifting and transporting, illustrations of which are here presented, the locomotive crane has many other ordinary and extraordinary uses in construction work that will be considered in subsequent articles.

Handling and Transporting

Locomotive cranes have been developed to a high degree of perfection in speed, variety, simplicity, capacity, and economy of operation. Different designs and details have been standardized by a number of expert manufacturers fabricating general and special types of machines.

In general, locomotive cranes are light and durable in comparison with any equivalent plant, are very simple and rapid in operation, and easily transferred from one kind of service to another. All their movements are operated by steam, gasoline, or electric power, the controls are simple and are conveniently arranged at a single point, where they are handled by one man, always in full view of the operations, and not handicapped by an incompetent assistant. Their capacity may vary from 5 to 50 tons, with boom 25 to 75 feet or more in length. The stability at short radius is sufficient for ordinary service, but may be greatly increased with little or no delay with the simple expedient of clamping the truck to the track. The boom can be rapidly swung around a complete circle, either loaded or empty, the crane travels by its own power and at as great a speed as is suitable for shifting and transporting operations. The crane is able to propel itself for many miles to remote localities where its services are required.

Loading and Unloading

One of the most obvious applications for locomotive crane service, and one to which it was early applied, is for loading and unloading materials, supplies, contractor's plant and machinery, freight, and all sorts of miscellaneous heavy articles to and from cars, trucks, and storage at terminals, construction plants, in contractors' yards, and on large public works, such as bridges, dams, retaining walls, and other structures involving the handling of a large amount of materials and appliances, especially where railroads or service tracks have been installed for general freight and transportation purposes.

For such services a whip line or tackle suspended from the boom is provided with a sling, hooks, bucket, skip, or other ordinary attachment. For special service other devices may be used, as in the case of an Orton & Steinbrenner crane mounted on an eight-wheel truck and equipped with an electro-magnet enabling it to handle numbers of heavy car wheels rapidly and conveniently.

Building Construction

In the construction of buildings where heavy materials or large units are used, locomotive cranes are found very convenient to unload trucks or cars, transfer if necessary across the site, and raise or lower to position. In the construction of the Adams Express building, on Lower Broadway, New York, Holbrook, Cabot & Rollins Corporation, contractor, handled a large quantity of timber, steel, contractor's plant, and various supplies and equipment with two Brown-hoist cranes, operated at street level, on tracks running across the full length of the site and supported by trestle falsework erected in the cellar excavation. These cranes also handled buckets of earth shoveled out of the cellar excavation and dumped them into trucks in the sreet, lifted, and set in place and removed heavy concrete forms, handled the concrete buckets, and deposited their contents in the forms. They helped to build the pneumatic caissons, installed boilers and other machinery, and commanded the whole area of the building lot, enabling all deliveries to be made quickly, and preventing the obstruction of the congested street by storage of supplies or materials.

Concreting Catskill Aqueduct

Rice & Ganey, contractors for a section of the Catskill Aqueduct, New York, used Brownhoist 15-ton steam locomotive cranes for general service, handling and even transporting plant and materials along the line of the open trench. The service tracks were laid parallel to the aqueduct, on the surface of the ground, one each side of the excavation, and on them the locomotive cranes operated to handle the spoil, deliver and remove timber, sometimes a number of pieces lashed together in bundles, and to set in place the steel forms.

The concrete mixing plant was installed near the aqueduct, and delivered concrete to large steel buckets that could be transported singly by the locomotive crane that dumped their contents directly into the form. For points of the aqueduct more remote from the concrete plant the buckets were loaded on flat cars hauled singly or, in trains to the locomotive crane which unloaded them wherever required.

Miscellaneous Uses

Among the various uses for which locomotive cranes have been found satisfactory in general contract work are the delivery of sand, gravel, and cement to concrete mixing plant; the delivery of buckets or cars of concrete from the mixing machine to the service track, or to the forms; delivering buckets of excavated earth or rock from the pit or trench to the surface of the ground, delivering muck from a tunnel to the spoil heap or dump car, handling rock or earth in the construction of fills and embankments, assembling, stripping, and transporting concrete forms; assembling, transporting, and installing foundation caissons; placing riprap under water or above water; building massive concrete or stone seawalls; building trestle viaducts; erecting short-span bridges complete; erecting separately long and heavy members or large bridge spans; erecting bridge tresses; placing, shifting, and transporting long-span truss centres for concrete arches.

These and other services in the simple lifting and transportation required in construction operations are among the many applications of locomotive cranes to general contracting operations. Various types and sizes of machines form part of the regular equipment of general contractors, and are transferred from one job to another, where they are always useful, not only for the very large amount of derrick service here referred to, but also available for many kinds of special service to which they can often be adapted by simple modifications.—Contracting.

Railway Company Incorporated

Official notice has been given of an application to the Quebec Legislature for power to incorporate the Quebec and Atlantic Railway Company and to build a line from Quebec City to Chicoutimi and from there to a point near Cape St. Charles, on the Labrador Coast, with the right to build branches north and south of the main line and to connect with the National Transcontinental Railway. The capital is $1,000,000.

Electrical Engineers See Toronto Harbor Improvements

THE Toronto section of the American Institute of Electrical Engineers made a tour of the new Toronto harbor developments on Friday afternoon, Oct. 26. The trip, carried out in the launches of the Harbor Commission, embraced a complete survey of the work of reclamation and construction being carried out in the harbor. A visit to the Don diversion gave a view of the extent of the reclamation work east toward the Coatsworth Cut and west where factories and warehouses are gradually clustering on the reclaimed area. Most notable among these factories at present is, of course, that of the British Forgings plant, which extends from Cherry Street east to the Don roadway. Side by side with this, the world's greatest electric steel plant, it is hoped the near future may see the erection of a steel plate and sheet mill sufficient at least to take care of Canada's growing shipbuilding industry.

The development of the industrial district at the east end of the bay is proceeding fast. Ships are being constructed along the eastern shore; the 400-foot ship channel, with its turning basin, at the foot of Carlaw Avenue, is visibly taking shape, and the concrete marginal ways and streets nearing completion.

From the eastern channel the cruise was routed through the lagoon, which, in view of the reclamation work completed at Ward's, Sunfish and Muggs' Island, now extends practically the whole length of the group known as Toronto Island from east to west. The last portion of the trip was an inspection of the new waterfront, with slips extending from Bathurst to John Streets. The tour was carried out through the courtesy of Mr. Wainwright and his colleagues of the Harbor Commission.

Prominent Engineer Killed in Action

Lieut.-Col. Thomas C. Irving, Jr., D.S.O., commanding officer of the 1st Canadian Engineers, has been killed in action. Lieut.-Col. Irving went overseas with the first Canadian contingent as a captain with the Canadian Engineers. In October, 1915, he was gazetted major of the Second Field Company Engineers. He was decorated with the D.S.O. for distinguished conduct on the field and later was promoted to a lieutenant-colonel. Lieut.-Col. Irving was one of Toronto's most popular officers, and an outstanding figure in military and engineering circles. He was a member of the Engineers, National and University Clubs.

Seven Camp Buildings Erected in Seven Hours

An example of remarkably speedy erection was furnished at Camp Dix, one of the United States army cantonments. On Sept. 24 seven barrack buildings, 24 x 157, designed for the use of orderlies and nurses, were erected, complete in every detail, in seven hours. This is an exceptional record, as it means that one building was completed every sixty minutes, on the average. Work was begun at 9 o'clock in the morning and carried on until the buildings were completed. Floors were laid, stairs in place, doors hung and windows fitted in, roof on, and even screened in, and all scaffolding had been removed and the workmen left the building.

Improvements in the Manufacture of Silica Bricks

By C. E. Nesbitt and M. L. Bell *

THE study of silica refractories is receiving more and more attention, as shown by the increased number of articles appearing in the technical magazines. The published literature so far has dealt mainly with the theoretical study of the raw materials, while the practical side has received very little attention. Theoretical information is of extreme importance, but its importance is negative until put to practical use. The brick manufacturer is not, as a rule, a man of theoretical training, hence theoretical investigations to be of use to him must be expressed in simple and explicit terms, easily understood. This does not, however, excuse the maker, who in most cases has been negligent in regard to investigations of the properties and improvement of his own product. The consumer has also been at fault, in that he has not freely co-operated with the maker and informed him wherein the brick failed. To obtain the best result it is necessary that these three—the investigator, the maker, and the consumer—should work together with heartiest co-operation.

Highly Refractory

In the manufacture of iron and steel, silica bricks find their greatest use in the open-hearth furnace. The demand here is for a brick of high refractoriness which does not become soft or plastic at working temperatures. The silica brick fulfils these requirements, in that it is refractory and does not yield to compression unless the stress is sufficient to crush it. The ability of silica brick to stand when only a small portion of the original wall is left is well illustrated in the bulkheads. This wall when built is 18 inches thick, but wears away in spots to less than one inch in thickness, and still the brick retains its place.

In the by-product coke industry the development of the use of silica brick is interesting. Formerly a quartzite brick was used, which was made of a mixture of clay and ganister. The object of the quartzite brick was to overcome the shrinkage and settling common to fire-brick. Some twelve years ago silica bricks were used experimentally in both beehive and by-product ovens. The experiment proved so successful that their use increased rapidly. Not only did their expansion on heating produce close, well-fitting joints and overcome settling difficulties, but their better conductivity greatly reduced the coking time.

In the manufacture of silica bricks in this country the raw material used is quartzite rock, commonly known as ganister. It is essential for high-grade silica bricks that the ganister be hard and dense. The rock should analyze about 98 per cent. silica, with 1 per cent. each of iron and alumina. The raw material is broken to convenient size, dumped into a wet pan, and ground with water and lime. The degree of fineness and the amount of water is left to the judgment of the operator. This is a source of considerable variation, as it will be shown later that the degree of fineness has considerable influence on the strength of the finished brick.

The binder commonly used is lime. Two per cent. has been found to give the most satisfactory results. Percentages greater than this lower the refractoriness and decrease the strength of the brick, while percentages below 1½ per cent. do not give a satisfactory bond. Binders such as iron, alumina, talc, water glass, and other substances have been tried, with more or less success.

The amount of water necessary to produce a satisfactory working mud varies somewhat with the kind of rock used, amount of calcined material present, and the method of manufacture. The percentage of moisture present is important. About 10 per cent. of available moisture is the proper amount for hand-made bricks. Too wet a mud will produce shapes which distort after being taken from the mould, while too dry a mud is responsible for a number of very serious defects, such as unfilled corners, sponginess, improper slicking, and lack of cohesion, all of which tend to give a finished product of low mechanical strength, very susceptible to spall, and slag penetration.

Process of Moulding Important

The moulding is a very critical point in the manufacture of silica brick. Improper filling of the moulds, too wet or too dry a mud, improper slicking, dirty palette boards, or careless handling, all contribute their share to the making of a defective product. The defects can largely be eliminated by close inspection and rejection of all but good bricks. As an illustration, bricks were received from a certain company which were poor in quality. The spalling loss was very high, running from 50 to 60 per cent. An investigation was made of the methods at the plant, and irregularities of mixing, moulding, and burning were found. Careful inspection was applied at certain points in the brick manufacture, and to-day this same plant, with no radical change in its general method, is producing bricks much more uniform in shape, strength, and appearance, and with a spalling loss of only 25 per cent.

Drying of the bricks after moulding is accomplished either on a hot floor, heated by steam, or in tunnels heated by hot air from the kilns. Drying on the floor is naturally the slower of the two methods, four to six days being required for nine-inch bricks and proportionally longer for larger shapes, while drying in tunnels may be accomplished in 18 to 24 hours. It is important that drying shall be done carefully and thoroughly, for unless the material is bone-dry when placed in the kilns, fire-cracks are apt to result.

The dried bricks are set in kilns, which are usually of the down-draught type, ranging in capacity from 50,000 to 150,000 bricks. It is important in setting that the bricks be true to shape, in order that they have a proper bearing and stack well. Green bricks will not sustain a load of much more than 100 pounds per square inch, hence care should be taken not to overload them. Shapes should not be placed near fire-boxes nor bear much weight. They are frequently boxed in.

Burning and Cooling

Complete burning requires from 10 to 15 days, with a gradual increase in temperature until at least cone 16

* Read before American Society for Testing Materials.

is attained (1,450 degrees C., or 2,642 degrees F.). The final temperature must be held a sufficient length of time to thoroughly and uniformly heat the entire kiln, which may require anywhere from one to three days, depending on the size of the kiln.

The cooling usually requires about five days, and is accomplished by gradually opening the fire holes and doors until the bricks are cool, when they are removed and placed directly on cars or in the stock house.

Tests of Silica Brick

With a view to studying the effect of degree of fineness of material and pressure, an experimental series of silica bricks was made with these two factors as the only variables. A good quality of Pennsylvania ganister was selected and ground dry in three lots to pass a 12, 8, and 4-mesh screen respectively. To the ground material was then added the water and lime so as to give 9 per cent. of moisture and 2 per cent. of lime. From each of the above meshes standard nine-inch bricks were made on a small hydraulic press at eight different pressures, varying from 187 to 2,500 pounds per square inch. The bricks were dried, burned, and cooled, following regular silica-brick practice, and were then subjected to certain physical tests to determine density, resistance to impact, resistance to spall, resistance to corrosive action of slag, and expansion due to heating. A summary of the results is given in Table I., in which the results of the three meshes are averaged according to pressure:

Table I.—Tests of Silica Brick, Arranged According to Pressures

Pressure under which Brick were made, lb. per sq. in.	Apparent specific gravity.	Impact, in.	Percentage spalled.	Slag penetration, sq. in.: Open-hearth slag.	Slag penetration, sq. in.: Heating-furnace slag.	Expansion, lin. in. per ft.
187	1.50	47	45.5	3.48	2.28	0.155
500	1.58	46	48.3	3.68	2.42	0.155
750	1.59	60	53.2	3.63	2.41	0.158
1000	1.63	65	51.4	3.79	2.42	0.160
1250	1.65	68	47.9	3.65	2.50	0.155
1500	1.66	65	43.6	3.82	2.50	0.160
2000	1.67	67	44.8	3.64	2.45	0.159
2500	1.68	71	42.0	3.72	2.50	0.160

Table II. shows the results of the various pressures averaged according to mesh:

Table II.—Tests of Silica Brick, Arranged According to Mesh

Mesh.	Apparent specific gravity.	Impact in.	Percentage spalled.	Slag penetration, sq. in.: Open-hearth slag.	Slag penetration, sq. in.: Heating-furnace slag.	Expansion, lin. in per ft.
4	1.66	57	30.4	3.92	2.63	0.156
8	1.62	63	47.6	3.67	2.39	0.159
12	1.58	64	63.2	3.44	2.29	0.159

Table I. indicates that little is gained by increasing the pressure. Table II., however, shows the importance of the selection of mesh. It will be observed that the strength as indicated by the impact test is greatest with the fine-ground material, while the percentage loss by spalling increases with fineness of mesh. Two very important properties in first-class silica bricks are the mechanical strength and resistance to spalling; hence, from the data we must select a mesh at the expense of one of these properties. More is gained by the coarse mesh; hence we advocate for silica bricks a coarse-ground material.

Table III.—Losses by Spalling, Expressed as Percentage

Mesh.	187.	500.	750.	1,000.	1,250.	1,500.	2,000.	2,500.
	Pressure under which brick were made, lb. per sq. in.							
4	21.9	34.9	37.9	38.7	31.4	30.4	19.1	29.1
8	51.6	45.9	62.6	51.0	43.3	34.8	38.3	43.3
12	62.9	64.0	59.2	64.4	69.1	65.8	67.0	53.6

Table III. gives the individual losses by spalling for each pressure and mesh.

The average spalling loss for hand-made silica brick is about 30 per cent. From Table III. it will be noted that power-pressed silica bricks were made with the same spalling loss from four-mesh material pressed at 1,500 pounds per square inch. These bricks were true to shape, sharp-cornered, dense, and had smooth, marble-like surfaces. Moulding defects, such as soft corners, sponginess, improper slicking, and lack of cohesion, were all eliminated. The prospect of the adoption of power pressing as a step towards better and more uniform silica bricks was clearly brought out by this series of tests. The idea of power pressing is not entirely new, yet little has been done in a commercial way. One of the large concerns is now manufacturing bricks this way on a commercial basis. The average spalling loss of these bricks is 25 per cent.

Three Primary Causes of Silica Brick Failure

In actual service, although well guarded as far as practice and construction will permit, silica bricks fail from three primary causes—spalling, crushing, and slagging. These cannot be entirely eliminated, but by a deeper study of the manufacture they can be reduced to a minimum. An ideal brick must be well moulded, true to shape, thoroughly bonded, and of good mechanical strength.

A visual inspection of almost any shipment will show at least 20 per cent. of defective bricks. Six shipments of bricks of different brands brought out the fact that 60 per cent. of the defects were due to moulding, 30 per cent. to fire cracks, and 10 per cent. to improper setting and irregular shapes. These defects can be largely overcome in the present method of manufacture by careful inspection and rejection of the improperly made bricks at certain points in the manufacture.

The ganister must be carefully selected and sorted; all rock that is soft or which carries considerable iron, clay, sandstone, or other foreign matter should be rejected. The ganister selected should be ground to just pass a four-mesh screen, care being taken to avoid an excessive amount of finely-ground material. To ensure uniformity, frequent sieve tests of the mud should be made. To secure a sufficient bond, 1.75 to 2 per cent. of lime should be used. In order to avoid irregular shapes and moulding defects, 9 to 11 per cent. of water should be used for hand-made bricks, and the material should be pounded into the moulds. The bricks should be thoroughly dried, so as to avoid fire cracks when placed in the kiln. Great care should be used when heating, especially during the first part of the burn, to prevent fire cracking; this applies also to the cooling. The bricks as they are removed from the kiln should be carefully inspected and all showing moulding defects, fire cracks, and irregular shapes should be rejected.

The consumer should be allowed to inspect the bricks before they are loaded on the car and a place provided for storage of such bricks as he may desire to test.

Paints for Metal Surfaces

Paper read Before Affiliated Engineering Societies of Minnesota Described Various Protective Coatings

By H. A. Gardner

IN designing protective coatings for metal the modern practice has been to apply the results available from researches into the causes of corrosion. These results have shown that materials of a basic nature or substances which contain soluble chromates prevent the rusting of iron. For this reason pigments of a basic nature or pigments containing the chromate radical have come into use in the manufacture of protective paints. That they are the best has been proved by practice and by test. This article will take up the use of the various pigments under separate headings, considering the paints suitable for use on structural steel, bridges, railroad equipment, ornamental iron work, poles, posts, and general work on metal surfaces.

The red lead paints may be purchased in the market ground to a heavy paste in linseed oil, ready to thin for use. One of the most valuable properties of red lead is its ability to set up a hard, elastic film that shuts out moisture and gases apt to cause corrosion. This cementing action is due to the presence of unburnt litharge, a pigment which reacts upon linseed oil to form a lead linoleate compound; it will be seen, therefore, that red lead free from litharge has no cementing action, and should not be considered more protective than iron oxide or any other similar neutral pigment. It is essential that red lead should be highly basic and should contain a considerable percentage of litharge if the iron is to be protected from corrosion.

Red Lead Paints

It is a growing custom to use prepared red lead paints made from finely-ground red lead and linseed oil. These paints remain in excellent condition for a long time, have a high protective value, and are well suited for general purposes. They are used extensively for priming steel vessels.

Of the red paints, iron oxide has been one of the most widely used pigments for the manufacture of protective coatings. There are many grades, from the brilliant red containing 98 per cent. down to the natural mined brown shale oxides containing from 30 to 60 per cent. of ferric oxide, the balance being silicia, clay, etc. It is customary to add to iron oxide from 10 to 20 per cent. of zinc chromate, zinc oxide or red lead, in order to make them rust inhibitive. These paints are used largely for tin roofs, metal siding, and structural steel.

Mixtures of white lead and zinc oxide, tinted gray with carbon black, are widely used, and give excellent results. The use of two parts of blue lead and one part of linseed oil containing about 5 per cent. of turpentine drier also makes a useful paint of about the proper consistency. The rust preventive value of this paint is due to the high percentage of lead oxide or litharge. It may be purchased ground to a paste in oil.

Black paints are often preferred for the final coat on steel work. Carbonaceous paints are unsuited for direct application to the metal, and carbon pigments, such as gas carbon black, oil black, or graphite, are usually used. Magnetic black oxide of iron forms an excellent black protective paint when ground in linseed oil. Willow charcoal is not made in commercial quantity, and its use is restricted on this account. Its rust preventive value depends upon the basic nature of the impurities present.

Green paints, formed from mixtures of zinc chromate and Prussian blue in oil, are highly protective, and have proved satisfactory in long service tests. Chrome yellow tinted with black oxide of iron to an olive shade is very permanent and protective. Chrome green made from lead chromate and Prussian blue is often used with a barytes base.

Bituminous Coatings

Bituminous coatings have a wide use for special purposes. They may be made by blending a refined coal-tar pitch, asphalt, linseed oil, and oleo-resinous varnishes, afterward thinning with turpentine or light mineral thinner. A heavy-bodied blown petroleum residual pitch has recently come into wide use. This has high resistance to acids and is not readily acted upon by the sun.

When coal-tar is used in the manufacture of paints it should be refined by heating to about 115 degrees C. until the water is evaporated. From 5 per cent. to 10 per cent. of lime may be stirred in to neutralize the free acids. The addition of Chinese wood oil and asbestine in a coal-tar paint aids in producing a more resistant film.

Bituminous paints of the above composition are used as coatings on pipe lines in acid factories on metal submerged in water, and for similar work. For such purposes it is generally advisable to first coat the metal with a hard drying prime coating made by adding two pounds of litharge to a prepared red lead or other protective paint. The bituminous paint may then be applied. Steel mine structures subjected to sulphur water and gas, reservoir tanks containing water, tunnel metal, etc., may be preserved from corrosion by this method.

Galvanized iron must be painted to be kept from rusting. Paints are apt to peel from it on account of the smooth surface. This condition may be remedied by treating the metal with a solution of copper salts before painting. This may be prepared by dissolving four ounces of copper acetate, copper chloride, or copper sulphate in a gallon of water and brushing this solution on the galvanized iron.

Tin plate will corrode rapidly unless protected by paint. Before applying the paint, the sheets should be rubbed with a cotton rag saturated with turpentine or benzine, to remove the oil on the surface. Iron oxide paints are widely used for preserving tin. For dipping purposes turpentine or mineral spirits should be used for thinning. Cheap driers with a low boiling point or benzine should be avoided.

Military Hospitals Commission Has Building Organization

THE Military Hospitals Commission of Canada has just issued a report of its work up to May, 1917, outlining the problems of the commission in connection with the care of soldiers returned from overseas who are under the need of medical surveillance. At the time the report was made the commission had 57 institutions under its control, besides 14 others where accommodation was available. It has been necessary to erect many new hospitals and make considerable structural alterations to buildings originally intended for other purposes. In view of these building activities a works department was formed, under the charge of an officer of the Engineer Service of the Department of Militia and Defence. Several draftsmen and building experts were loaned by the Department of Public Works. The report states that it has been found that the Military Hospitals Commission is able to save a very considerable sum by undertaking the work itself rather than by employing outside architects and overseers. In connection with its contracts, it is stated that, where possible, public tenders are called for, but when it is necessary to rush a building it has been found more economical to employ one of the principal builders of the locality and to pay him a percentage on the cost.

Strength of Nail Joints in Douglas Fir and Western Hemlock

Tests to determine the strength of nail joints made with wire nails used in single shear in Douglas fir and hemlock timber have been made by the Bureau of Buildings of Portland, Ore. The tests were conducted under the direction of Mr. Henry Blood, Engineer of the Bureau. The results obtained are described in a recently issued report, which was put into its final condition by Mr. H. E. Plummer, Inspector of Buildings. It is published in Engineering and Contracting.

The report covers the testing of 110 joints, of which

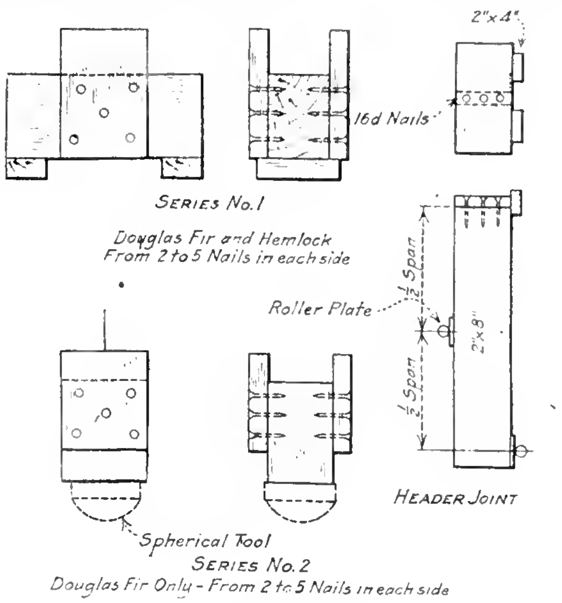


Fig. 1—Types of Joints

87 were made of Douglas fir and 23 of western hemlock.

The tests were divided into two series, depending upon the style of the joints (see Fig. 1). In the first series, two side pieces, each with the grain of the wood vertical, were nailed to a center piece with the grain of the wood horizontal.

For the second series, two side pieces, each with the grain of the wood vertical, were nailed to a center piece with the grain of the wood also vertical.

Contact Between Planed Joints

In the first series, joints both of Douglas fir and western hemlock were tested, but in the second series, joints only of Douglas fir were tested. In making the tests, it was desired to introduce such variables that the lateral resistance of nails under various conditions be quite clearly brought out and understood, and with this in mind, the number of nails in a joint, the size of the nails, as well as the size of the side and center pieces were varied. The size of the side pieces varied from 1-in. by 6-in. to 2-in. by 8-in., and the center pieces from 4-in. by 6-in. to 6-in. by 10-in., the dimensions given indicating commercial size which varies from ⅜-in. to ¼-in. less than the dimensions given. The nails used were common wire nails, ranging from 10-penny to 60-penny in size and the number of nails used in each side piece varied from two to five. The size of the pieces was such that nails had a penetration in the center piece of from 30 per cent. to 80 per cent. of the length of the nail, but in all cases, the nails were used in a single shear, in no case passing through the

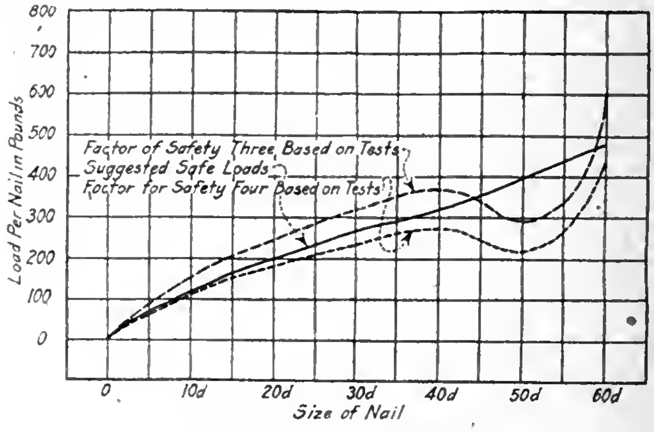


Fig. 2—Safe Loads on Nails

center piece. All timbers were surfaced so that contact in the joints was between planed surfaces only.

The joints were tested by placing them in a Riehle testing machine and forcing the side pieces down and by the center piece. Accurate measurements were taken of the relative movements of the pieces making up the joints. In addition to the two series of tests, two joints were tested in which the nails were driven parallel to the grain of the wood.

The following is a summary of the results obtained by the tests. The average ultimate load carried per nail is as follows:

Series No. 1—Douglas Fir

No. of tests	Size of nail Penny	Ultimate load carried per nail
14	10	525
9	16	600
10	20	749
10	30	922
5	40	1,183
1	60	1,800

Series No. 2—Douglas Fir

5	10	407
9	16	628
12	20	751
6	30	992
1	40	1,023
1	50	873

Series No. 2—Western Hemlock

6	10	519
4	16	588
7	20	695
6	30	579

An inspection of the above values shows the irregularity and apparent unreliability of the single test made on the 50-penny and the 60-penny nail joint. The resistance of the 50-penny joint for some reason was low, while the resistance of the 60-penny joint was high. That this must be the case can be readily seen when the results obtained by other investigators are examined. Also a curve of the values for the lateral resistance of nails as indicated by the tests shows uniformity for the 10-penny, 16-penny, 20-penny, 30-penny and 40-penny nails, but shows pronounced breaks for the 50-penny and 60-penny nails. (See Fig. 2). The average ultimate load per nail carried by header joint with nails driven parallel to the grain in the wood was for 16 d. nails, 446 lb.

Safe Values

The following conclusions, based on the tests, are given in the report:

The tests indicate that safe values for nails driven in perpendicularly to the grain in Douglas fir or western hemlock with a load perpendicular to the length of the nail are:

	Lb.
10-penny nail	120
12-penny nail	130
16-penny nail	160
20-penny nail	200
30-penny nail	270
40-penny nail	320
50-penny nail	400
60-penny nail	480

These values should be reduced if the penetration of the nail in the holding piece is less than 50 per cent. of its length. They give a factor of safety based on the ultimate load of considerably over three in all cases and in most cases of nearly four.

The resistance of nails driven perpendicularly into timber with the grain of the wood parallel to the loads is but little more than for nails similarly driven with the grain of the wood perpendicular to the load.

Reduction for Nails Driven with the Grain

The test of nails driven with the grain of the wood indicates that the safe loads given in the previous conclusion for nails driven perpendicular to the grain of the wood should be reduced 25 per cent. The safe loads for nails driven parallel to the grain of the wood with a load perpendicular to the length of the nail are:

	Lb.
10-penny nail	90
12-penny nail	90
16-penny nail	120
20-penny nail	150
30-penny nail	200
40-penny nail	240
50-penny nail	300
60-penny nail	360

Tests were made on the 16-penny size only, but the reduction in safe loading was considered to be the same over all nails.

The tests show that nails in western hemlock have so nearly the same resistance as in Douglas fir that the values may be considered the same.

Slip occurs under quite small loads and increases in proportion to the load until the ultimate load is reached, at which time slip continues with a decreasing load until failure occurs.

In the tests, no elastic limit of joints could be determined, but the recommendations of previous investigators that a slip of 1/10 in. be considered as an elastic limit seems reasonable, as the load with such an amount of slip varies from 50 per cent. to 60 per cent. of the ultimate load carried.

The amount of slip is affected by the time element and increases slowly over loaded periods of 3 to 8 minutes. For Joint No. 8 the slip occurred at the rate of .003 inch per minute for 3 minutes for a load one-half of the ultimate, and increased with increasing loads to .02 inch per minute just before the ultimate load was reached.

Permanent Set

When the load is released after a small amount of slip has occurred, the joint does not entirely come back to its former position and retains from 1/16 to 1/10 in. permanent set. Upon reloading to the amount of the first load, the slip did not increase beyond the original amount.

The tests indicate that the nail heads are of proper proportions as there seemed to be no difficulty in connection with the nail head pulling through the outside timber.

The strength of the joint seemed to be affected but little by the penetration of the nail in the centre piece, if the penetration of the nail in the centre piece was 40 per cent. or more of its length, but with lesser penetrations the loads were reduced and for a penetration of 30 per cent. the strength reduction amounted to about 25 per cent.

Each nail in a joint seems to support an equal proportion of the load.

Large nails do not offer as much internal resistance as the smaller ones, proportionately or per pennyweight.

It is of interest to note that the bearing of a nail on wood when the joint approaches the ultimate load is greatly in excess of values given for ultimate crushing strength of timber across the grain.

Two Factors Involved

The two principal factors involved in the strength of nailed joints are the resistance of the timber to crushing and of the nail to bending. The resistance of the nailed joint, if depending solely on the resistance of the wood to crushing, varies as the diameter of the nail, other things being unchanged. On the other hand, the resistance of the joint if depending solely on the resistance of the nail to bending, varies as the cube of the diameter of the nail. As the resistance of the nailed joint depends on both the resistance of the wood to crushing and the resistance of the nail to bending, the resistance for different sizes varies somewhere between the variation of the diameters and the cube of the diameters of the nails. This variation corresponds quite closely with the square of the diameter of the nails.

The tests made show that further tests made with a wider range of variables are desirable and should include timber rough as well as finished and green as well as seasoned; nails covered with pitch; barb nails and finishing nails, etc. The tests might well include the effect of the falling load as well as one evenly applied and the effect of a load remaining in place for some time.

Labor-Saving Equipment for Track Work

EACH day shows more and more the scarcity of labor of all classes on the railroads, especially in the maintenance department, which employs a great number of unskilled laborers. These laborers are scattered in small gangs over a large territory which is more or less sparsely settled. The old-time home guard is passing away, which makes it necessary to import laborers of any and all nationalities, who must be properly placed. It is necessary then to provide comfortable living quarters for these laborers as an inducement for them to remain in this line of service. Work and boarding cars should be furnished in sufficient numbers and in such condition that laborers will be satisfied. This can be done by a number of methods, some of which are bunk cars with cook and kitchen cars, permanent laborers' houses and portable laborers' houses for more or less transient gangs, and last of all, tents. It is hard to estimate the saving or return which warrants this expense, but it is absolutely necessary that they be provided over the entire system to keep anything like an ordinary working force. To offset the growing scarcity labor-saving devices are extensively employed. Those used on the Illinois Central Railroad were described at the Road masters and Maintenance of Way Association by E. S. Boland.

Steam Ditcher Saves Money

The steam ditcher is one of the greatest labor savers in operation today. The company now has nine ditchers of the boom type, seven of one and two of another make. The saving with the operation of each one of these machines is estimated at 10 cents per yard on 250 cubic yards per day over the next best method. Six months' operation per year will save about 50 per cent. on the investment. If the work is heavy or if a sufficient number of machines is furnished, it is possible to work these ditchers in pairs; that is, two machines with one work train, making a further saving in expense of at least 5 cents per yard. In addition to operating as ditchers, these machines can be used in loading and unloading rail, relaying rail, loading and unloading bridge timbers, loading ties, taking up abandoned tracks, transferring loads of timber, loading cinders, loading gravel ballast, excavating for scale pits, turn-table pits and building foundations, excavating or building embankments for new sidings, loading heavy scrap, loading trucks and light wrecking.

Air dump cars in place of flat cars in ditcher service are of great value. The old method of handling dirt loaded by ditchers was to use a train of 10 or 12 steel under-frame flat cars over which the ditcher operated by its own power, backing away as the cars were loaded. After loading, a Lidgerwood with plow and cable was necessary to unload the flats. In order to protect the ballast while unloading it is also necessary to equip the cars with aprons, which makes an additional expense. The present method is to operate two 20-yard air dump cars with each ditcher, one ahead of the machine and one behind. By this method the cars are easily loaded and can be unloaded immediately. Mr. Boland's experience has been that a saving of 4 cents per cubic yard can be made, based on 125 cubic yards per day, which figures about 22 per cent. on the investment, based on six months' operation per year. This also releases the 10 or 12 steel under-frame flat cars for revenue service and the Lidgerwood for heavier work in unloading gravel ballast.

Unloaders Save 50 Per Cent. on Investment in Six Months

The company now has 11 Lidgerwood unloaders. These machines are used on various parts of the system in unloading gravel ballast, sand for track elevation, dirt, strippings for banking and any similar heavy work which is found necessary. A trainload of gravel from the Foreston, Ill., pit consisting of 35 Haskell & Barker cars of about 30 yards each can be unloaded with one of these machines in about 30 minutes, provided the material is unloaded continuously. This operation would require 210 men for about 2½ hours without this equipment. These machines, when operated six months of the year, will save at least 50 per cent. on the investment.

The company has provided each roadmaster and track supervisor with an inspection car, which has increased the efficiency of these officers over 100 per cent. The track can be given much closer attention than by any other method. The entire district of 100 miles can be covered in two days without trouble, enabling these men to give close attention to the work and to confer with every foreman and road department employe en route.

There is no question about the economy of placing a motor car with every section, bridge and signal gang. Until recently the company had only a few sections so equipped with cars of company ownership. A great number of men had realized the advantages that could be obtained from motor cars and had purchased engines themselves from various makers, which were installed on their hand cars. It was found after three or four years that almost every make of engine was being operated and instructions were issued that no more engines should be purchased by foremen to operate on the company lines. Last spring the road purchased a number of section cars and during the summer and fall of the present season an additional order was placed for a sufficient number of cars to equip all of the gangs mentioned. This order was divided between three companies. Arrangements were also made to purchase the engines from the foremen, so that the company would be the sole owner of all of the motor-car equipment on its lines. It is estimated that one hour can be saved for each gang each day by a motor car. The men are also fresh on arriving at their work and do not dread the homeward trip at the close of the day's work. The additional advantage obtained in this class of work is that the gangs often travel long distances. The men are carried to their work with the greatest dispatch and are not worn out by the trip. It is not necessary to move the camp outfits nearly so often, which saves car mileage and switching. It is much easier to obtain labor and the men are much better satisfied.

Motor Car Mowing Machines

After trying out a motor car mowing machine for two years it was found so desirable that 13 more were purchased, one for each division on the system. These cars will mow a neat swath on each side of the track at the rate of about 30 miles per day. Each machine will save its cost every year.

The nine tracklaying machines which are now operated by the company have been of great service in offsetting the labor situation. They are a great relief to the men, as the machine does all of the heavy lifting. The gangs can be reduced or more rail laid than was possible with the same gang prior to operating the machine. The ordinary new rail program on this road includes between 50,000 and 60,000 tons per year and any reduction in the cost of laying this rail cuts down one of the largest items of expense.

Each division is now equipped with an approved air rail loader which can be operated with three or four men, whereas this work formerly required about 20. A saving of this kind is an absolute elimination of all of the useless work which was formerly done by hand. A modern railroad cannot afford, in the present day, to handle rail without a device of this character.

Tool grinders have come into the maintenance of way world to stay. In taking the place of the old grindstone, it relieved about the most cumbersome tool that was carried on the hand or motor car. Grinders cost from $12 to $25, depending on the number of attachments provided with the machine. Tools can be kept in better shape and the machine saves its first cost in one season.

Portable Rail Saw

The company is now operating one portable rail saw at Clinton, Ill., and authority has been granted for an elaborate permanent sawing plant to be located at Centralia. All second-hand No. 1 rail of the 85-lb. and 90-lb. class is sawed and re-drilled before relaying in branch-line main track. The sawing process makes infinitely better riding track and adds greatly to the life of second-hand rail. It is figured that about $2 per ton will take care of the expense of handling and sawing. The riding of track has improved 100 per cent. by using sawed rail, in comparison with the old method. The results accomplished have been well worth the expense.

Snow thawing outfits are almost a necessity in large terminals. The greatest advantage in these outfits is that it is not necessary to reload snow and ice taken from switches and interlocking plants. In congested territory it was formerly necessary to cast snow out of the switches and in some cases it would have to be handled five or six times before it was finally disposed of. Snow thawers give immediate relief and do away with the re-handling. One man with one of these outfits can accomplish as much as three or four by the old method.

Cars to Take Care of Cinders

Each terminal should have a sufficient number of cinder cars to take care of all of the cinders handled without using cars in revenue service. Cinders are now loaded at large terminals with some approved form of clam shell, but it still remains for the section men to unload the cinders out on the line. The side dump car with ridge bottom is the best class of car in service. It is proposed, however, to make these cars large enough to hold 50 tons of cinders, which would cut down the number of cars and greatly aid in the distribution. Ordinarily the Illinois Central cinder cars have been made from old condemned coal cars and were of very light capacity. It is almost impossible to estimate the amount of money lost in the maintenance department on account of using coal cars, especially during freezing weather and the rush of business when cinder cars are not available.

Position of the Engineer in the Community and His Relations to the Contractor

THE engineer is primarily a man whose life is devoted to promoting and planning things that actually happen, and without doubt he is slowly but surely assuming his rightful position in the world, because it is becoming universally recognized that he, above all of his fellows, is better fitted by his education, experience, and, generally, his temperament to fill those positions in the direction of the world's material progress which require, among other things, sound, sane and intelligent judgment and at the same time administrative ability, energy, technical and scientific knowledge of a high and varied order.

Of course, initative, candor, truthfulness and efficiency, and, above all, integrity, are presupposed and let us hope can usually be taken for granted.

Engineering an Art and a Science

Engineering is an art and a science. It is a science in so far as certain physical laws are its basis. It is an art in so far as in the application of these laws the best judgment inherent in or acquired by man must be exercised. It is the engineer who is the pathfinder and pacemaker in modern civilization, and it is he who more nearly than any other individual can be likened unto Jove of old, whose command of the elements used to be universally acknowledged and is proverbial, and it is the engineer who, today, is largely charged with encroaching on his ancient and honorable preserve.

Little progress would be made in the modern world if the engineer did not blaze the way, and a giant's share of the progress in material things which has been made since the birth of the First Napoleon has been made by engineers, and incidentally it may be observed that, since his birth, there has been more actual progress than was made during two thousand years that preceded it. That there is far more difference between our world and that in which Bonaparte was the central figure than there was between his world and that of Julius Caesar, most of which difference has mainly been brought about by the engineer, cannot be disputed. Much yet remains to be accomplished. Unknown and exhaustive domains no doubt are still to be explored and exploited, but, stupendous as is the task, the engineer will, when the day of reckoning arrives, be found to be in the forefront.

The Function of the Engineer

To cope with those impediments which Nature and man set up in the way of material progress, and to transmute or convert these into processes for the use and convenience of mankind, is the acknowledged function of the engineer, and he has not heretofore been, nor shall he in the future be, found wanting.

To be more specific, in the ultimate analysis the elemental components, physical, mental and moral, which in the ensemble constitute the engineer, as herein stated, may be said to be character and experience, imagination, efficiency, executive and technical ability and scientific knowledge. While no one of these principles can be said to dominate the rest, still in a general sense there is no disputing the fact that character stands first. It is the framework or foundation on which the other characteristics are built.

Technical ability and scientific knowledge are not

*From a paper by S. M. Swash, M. Am. Soc. C.E., in the proceedings of the Engineers' Club of Philadelphia.

written first because it is thought to be of little importance, but because ultimately the other principles being broader have a bigger bearing on the resultant man.

A man may be a great engineer with only sufficient scientific knowledge to eliminate the impossible and whose sole characteristics are his imagination, ingenuity, and experience, but who possesses a mind capable of conceiving or forecasting and in rare instances defining the desirable and necessary (as the case may be) in the human economy.

Creative Ability

Imagination is to be interpreted as broad vision, creative ability. Technical ability considers scientific knowledge applied in the light of experience, reason and common sense. Efficiency is generally defined as the ratio of the work expended to that produced and in a larger sense is the process of effectively correlating all of the operating forces and energies in one unit for economical production. Executive ability is the process of successfully commandeering and utilizing the services of others.

The provinces of engineering and economy are often intertwined to such an extent that it cannot be said distinctly just where one ends or the other begins. Engineering which is not economical is not good engineering, and economy which will not bear rigid scientific investigation or treatment, such as an engineer would subject it to, is not economy.

Where we attempt a rigid mathematical analysis in any instance, we must be sure of the premises, and it should be remembered that scientific analysis does not necessarily mean mathematical precision to the exclusion of the broader judgment based on experience and common sense.

An engineer's education after it reaches a certain stage should be along broad lines, to include the humanities, so as to fit him for leadership.

Knowledge of Men

A knowledge of men which the old school believes can only be had by contact, but which some now seem to think can be obtained through the mastery of what has been called the science of character analysis of Dr. Blackford, is more to be desired than a knowledge of integral calculus and by all odds gives one a better chance in life.

Many engineers are of necessity employed by industrial and commercial organizations. Some are born to lead and others to serve—in whatever class we find ourselves it is up to us to do our utmost. To be able to intelligently and successfully carry out orders is a faculty not to be despised and, by the way, it is not the easiest task imaginable.

Relation to Employers

In his relation to his employers it goes without saying that they are the sole judge as to his ability and fitness. In his dealings with them he must possess candor and ability to look out for their interests without sacrificing his own. It is a fact that is not to be disputed that he must be true to himself, first, and that he must not forget or overlook his own interests.

In every instance the contractor should receive a square deal at the hands of the engineer and in no instance should the engineer have it in his mind to get square with the contractor for some fancied or even real act of omission or commission. Those who have had sufficiently broad experience recognize that specifications are intended to be interpreted in the spirit, rather than in the letter. As Theodore Cooper, in his day recognized as the foremost bridge engineer in this country, put it, "The best system of rules to insure success must be interpreted on the broad grounds of professional intelligence and common sense."

Fault-Finding Detrimental

Constant bickering, indicating lack of poise and persistent petty fault-finding without being able to offer suggestions for the betterments of conditions, is the method pursued by many young engineers to the detriment of the work on which they are engaged.

There is absolutely no reason why the most cordial relations should not exist between the contractors and engineers engaged on the same work and there are probably the very best of reasons why they should, as their interests are alike.

The specifications are often the rock on which the cordial relations of the engineer and the contractor are rent asunder.

Contractors, like engineers, are actuated by the same motives as other men. The engineer may or may not be superior to the contractor, but he cannot show his superiority by taking undue advantage of him.

Contracting, according to the usual methods in vogue, of which some one has aptly said, "The profits are limited by competition, but the losses may be unlimited," should no longer prevail, but as it is or should be a legitimate business, the gambling element should be removed therefrom, and should certainly not exist to a greater extent than it exists in any other ordinary business.

Contractors would be better men as well as better contractors if their remunerations were fixed, rather than problematical as is usual.

The party for whom the work is being done should take all of the incumbent risks, and then any incentive of the contractor to take advantage is removed.

Specifications

Some specifications deliberately give the engineer the whiphand, but it has been determined in the courts of this country that it cannot be employed without considerable danger. As engineers we know that the action and reaction are equal.

Clauses which have a double meaning or which can be interpreted in two ways should not be written in specifications. A contract represents a meeting of the minds of the contracting parties. The engineer should not attempt to protect himself by inserting obscure clauses in specifications whereby he may cover up his own ignorance or shortcomings at the expense of the contractor.

Copying clauses from one specification into another without fully understanding their meaning, simply because they are time honored, i.e., because custom has sanctioned them, which is not unusual, is a very silly and at the same time dangerous practice.

Few men have ever been vested with considerable power who haven't at times abused it, and the engineer who prepares the specifications and who interprets them and who in the case of dispute has the last say, in fact is the "sole arbiter," has to be a bigger man than the ordinary to be absolutely unbiased. In the case in question the engineer is judge, jury and prosecuting attorney, all welded into one, and the one who usually suffers, and to whom is meted out the punishment, unless the engineer happens to be a very big man, is the contractor.

Waterproofing for Concrete

MANY of the structures being built in the present day require, at least in some portion, the use of waterproof concrete. Basements must stay dry during the rainy season of fall and spring, in spite of the fact that the walls are often standing in several feet of water. Tunnels should be free from the trickling streams, which may often be noticed dripping from their roofs and sides. Reservoirs, cisterns, tanks, and bathing-pools should hold the water contained in them without leakage. It is often necessary that floors prevent the passage of water through their mass to the story beneath. Hospital floors and walls should be non-absorbent. Concrete burial vaults must resist the entrance of moisture. Ornamental white cement concrete work should be impermeable to water and dry off immediately after a rain, instead of retaining a dark, ugly, water-soaked appearance for twenty-four hours. Stucco and concrete block walls should be moisture-proof. Concrete pipes should be impermeable to the liquids passing through them, and concrete silos should keep out the dampness which is the greatest foe of the preservation of the grain contained.

When one stops to consider that decay is hastened rapidly by the presence of dampness, which encourages germ growth and makes possible chemical reactions, likely to cause rapid deterioration, the importance of keeping moisture out of structures is apparent. The rotting of wood and the rusting of steel may both be minimized by preventing their contact with dampness or moisture. Human bodies have been preserved in Egypt for centuries owing to the lack of destructive action which attends the presence of moist conditions.

The need for waterproof concrete is beginning to be appreciated by engineering and architectural authorities, contractors, and owners. A recent issue of Cement World contains the following notes regarding waterproofing of concrete:

Rendering Concrete Waterproof

One of the oldest methods is known as the Membrane Method. This consists of the application of several layers of hot tar, pitch, or asphaltic material alternating with sheets of felt or building paper. The membrane is built up in successive layers upon the outside of the concrete wall. If below grade, extra excavation is required, and a retaining wall, usually of masonry, is necessary to protect the coating. Floors are sometimes treated in this way by putting down a brick mortared sub-floor, building up the membrane on this, and placing the concrete on top of this membrane.

Where there is but a small pressure of water against the coatings, the above method has proved quite satisfactory. Its cost, however, is considerably higher than the integral method. The membrane, moreover, is very delicate, and shows considerable depreciation with time. It is difficult to secure good adhesion to the concrete surface, and it is very likely to separate from the concrete. If any water gets between the concrete and membrane there is a greater tendency for the coats to come loose from the concrete. This frequently takes place owing to water from above entering between the two. In cases of this kind rupture of the membrane, due to freezing of the water, eventually takes place, and expensive repairs are necessary. Being high in first cost and expensive to maintain, the present tendency is to regard the membrane system more in the light of a damp-proofing medium than as a protection against water under more than moderate pressure.

Under the head of damp-proofings come also such asphaltic or heavy oil liquids as may be applied on the inside of basements, etc. These are likewise efficient where there is but a slight water pressure. It is difficult to secure even and perfect adhesion, however, and with much pressure the layer will separate or give way and peel off. Such coatings are unsightly in appearance, and many of them become sticky in hot weather.

Waterproof Paints

A kindred class of materials are the waterproof paints. Practically all of these have a linseed, China wood, or other oil base, and are subpect to quite rapid deterioration when exposed to weather or moisture. Here also is encountered the difficulty of making the paint adhere perfectly to concrete, and, though the paint generally affords temporary relief, it tends eventually to crack and peel off. A good paint of this kind, with an inorganic base, not subject to such rapid deterioration, would be a real boon to the building trade and the public alike. The present paints above described, while they possess the advantage of being obtainable in any desired color, and accordingly may be used to ornament gray cement stucco or concrete walls, possess the serious disadvantage that they must be replaced from time to time, in the same way that the paint on wooden surfaces must also be replaced.

Compounds of Questionable Value

Upon the market at the present time there are several classes of compounds open to severe question as to their utility. The first class of these comprises the few compounds containing from 10 to 30 per cent. calcium chloride, and the balance mainly water. Calcium chloride is white, crystalline, and very hygroscopic: in other words, it is so far from being water-repellent that it draws water from the atmosphere, dissolves in the water thus accumulated, and is likely to be washed away unless forcibly prevented. Solutions of it are, however, sold to the trusting buyer as waterproofing.

Another material described as a waterproofing agent, and one which should be tested instead of being taken on faith, is advertised as a reground cement. On test the writers were unable to find more than a trifling decrease in water absorption in comparison with ordinary portland cement.

Integral Waterproofing

The function of an integral waterproofing in concrete is shown by the following simple experiment: Place a handful of finely-ground water-repellent waterproofing powder in a pile on the surface of the water in a tumbler. Press one finger through the centre of the pile down into the glass. A very thin film of the powder will completely surround the finger, as may be seen by looking through the transparent walls of the glass. The finger will remain perfectly dry.

In waterproofed concrete this film is of very minute thickness. The particles of cement, sand, and stone fit together more or less closely, their weight being sufficient to force the waterproofing from between those of their surfaces which are in actual contact. The result is that a thin film is formed, bridging the pores. Upon being exposed to water pressure, this stretches and assumes the shape of the depression, forming a waterproof film, which reduces to a minimum the penetration of water and its absorption by the concrete.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

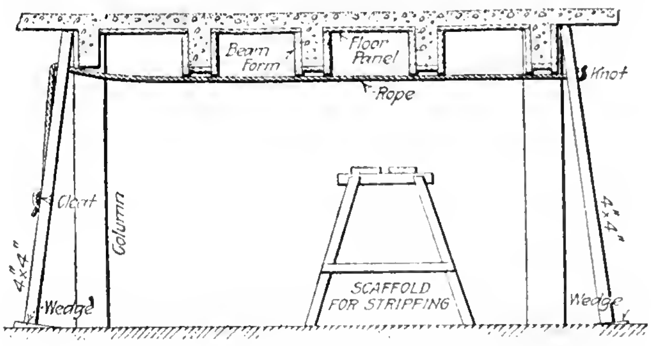
Ropes Simply Stretched Catch Form Panels in Stripping Floor

By Samuel Warren

A SIMPLE rig for catching floor forms in stripping, and one which insures the minimum of damage, is illustrated in the sketch taken from Engineering News Record.

The rig consists of pairs of posts, each made up of two pieces of 4 x 4 cut slightly longer than the clearance between the floor and the ceiling. About a foot below the top of each post a hole is bored. An inch rope is passed through the holes and knotted against one of the posts. The posts are then set as shown in the sketch, and are held tightly in place by a wedge at the bottom of each. The loose end of the rope is then pulled taut and held by means of a cleat.

After the shores are removed and the floor joists for the floor panels are knocked out, a scaffold consisting of planks on horses is placed underneath. From



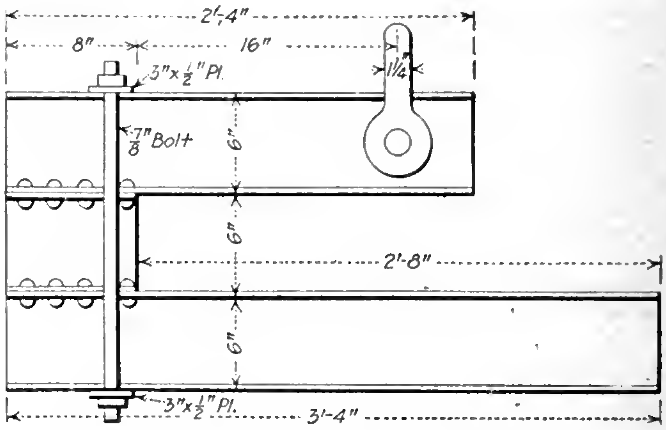
All the forms in a bay lowered to floor at once by slacking ropes

this the men work to loosen the beam and girder forms and floor panels. These fall but a small distance, being caught by the ropes. In case a form breaks loose, the workman can prevent injury to himself by ducking below the level of the ropes.

As soon as all the forms have been stripped they are lowered to the floor by loosening the ropes simultaneously at each cleat. The same apparatus can be used for stripping flat slab panels by leaning the opposite posts away from each other. A strain on the rope only serves to hold the posts more firmly, because they are slightly longer than the distance from the floor to the ceiling.

Hook Built of I-Beams Successfully Handles Large Concrete Pipe

The accompanying sketch from Engineering News-Record shows a hook for lowering large reinforced-concrete sewer pipe into the trench from a traveling derrick. It was made in the blacksmith shop of a large sewer job. The hook is made up from three 6-inch I-beams clamped together with two 7/8-in.



Hook solves problem of handling large concrete pipe

bolts and 3 x ½-inch plates. The beams are also rivetted together through their flanges. An inch and a quarter shackle is placed on the upper arm of this hook midway of the lower arm. Into this the hoisting line is hooked. Five-foot pipe was handled satisfactorily with this hook after considerable trouble had been experienced with the failure of hooks forged from one piece of metal.

Water Power Pictures Shown to Ottawa Engineers

The members of the Ottawa branch of the Canadian Society of Civil Engineers witnessed a moving picture demonstration at the Regent Theatre on Friday, Nov. 2. The films, depicting water-powers of Canada, were recently completed for the Dominion Government by the engineers of the Department of the Interior, in co-operation with the Department of Trade and Commerce. The pictures show water-powers tributary to Vancouver, Calgary, Winnipeg, and Montreal. They are now being screened before financial, professional, and technical organizations in the United States. Sets of the films have also been furnished the Canadian trade commissioners abroad, to be screened before interested parties in Australia and South Africa and eventually South America and European countries. By special request of a member of the Inventions Board of the Admiralty, a set has recently been forwarded to London, to be shown before high officers of the Admiralty and officials of the Imperial Government.

Building Permits in Welland, Ont.

The building permits issued in Welland, Ont., for the month of October amount to $21,004, as compared with $16,927 in the same month last year. The total for the first ten months of the year is $226,184, as against $176,125 during the corresponding period last year.

Mainly Constructional

East and West—From Coast to Coast

It has been decided to locate an aerodrome and flying school at Beamsville, Ont., and preliminary work is expected to start immediately.

Owing to the rapid increase in the population the city of Winnipeg will build several new schools in the spring at an expenditure of some $500,000.

It seems to be decided that the camp at Niagara will be continued during the winter, as cars of lumber and other materials for permanent buildings have been shipped in.

The new bridge of steel and concrete in Newmarket, Ont., which replaces an old iron structure on Huron street, has now been completed. It is 100 feet long and has a sidewalk on one side.

The Toronto Board of Education has given its permission for the use of twenty-five rooms of the new Park School for military hospital purposes. The school will be finished at the beginning of next year. General Logie has offered to supply men from the ranks to assist in rushing it to completion.

The B. J. Johnson Soap Company, Limited, are erecting a factory on Natalie Street, Toronto, at a cost of about $100,000. The new structure will be 200 feet long and 82 feet wide, with a floor space of 48,000 square feet. It is proposed to erect two storeys and basement now, and to add four additional storeys later.

The council of North Vancouver, B.C., has prepared a memorial to be submitted to the Dominion Government urging the construction of a dry-dock at Burrard Inlet as a government undertaking. It emphasizes the necessity of establishing a dry-dock capable of accommodating the shipping interests of the port of Vancouver.

For the month of October there were 77 building permits issued in the city of London, Ont., at a value of $143,460, as compared with 118 permits valued at $110,145 in the same month last year. The total for this year up to the end of October is 749 permits, valued at $718,290, while for the corresponding period last year 939 permits were issued at a value of $842,570.

The Rosedale section of the Bloor Street Viaduct, Toronto, has been taken over by the city and is now open for traffic. The Sherbourne section is completed with the exception of a certain amount of filling in which has been delayed owing to lack of material. The contractors expect to get enough earth from some of the larger buildings that are going up in various parts of the city to make up for this deficiency. The Don section is completed and ready to be handed over to the city.

It was recently announced by Mr. Ward B. Perley, vice-president and general manager of the Canadian Steel Corporation, that the contract for the company's new docks at Ojibway, Ont., has been awarded to the Great Lakes Dredging Company, Limited, of Port Arthur, Ont. The expenditure involved is approximately $1,500,000. Work is to be commenced at once. The slip will be 2,400 ft. long and over 200 ft. wide, built at right angles to the river, and the channel will be 23 feet deep, permitting the handling of the largest ore-carrying vessels plying the great lakes. The dock walls of concrete will be 9 feet high and 12 feet wide. Tenders have been submitted for the construction of about 200 houses. It is stated that there will be over 3,000 men working for the steel corporation in the spring.

The results of the road competition arranged by Robinson, MacBean, Limited, in the Moose Jaw, Sask., district, were recently announced. The firm initiated the competition with a view to encouraging the building and maintaining of better roads in the vicinity, and offered prizes amounting to $975. Entries were invited from different municipalities covering a territory of about 36 square miles, with Moose Jaw in the centre. In all sixteen entries were received, totalling sixty-five miles. These were divided into three districts, and in each district a first prize of $150, a second of $100 and a third of $75 was offered. In District No. 1 the results were as follows: First prize, A. W. Wallace's entry of six miles east of Belle Plaine; second prize, T. H. Abbott's entry of five miles; third prize, Robt. Baird's entry of four miles, running north of Pasqua. In district No. 2, J. H. Crosbie's entry of four miles takes first prize; A. V. Rathwell's entry of four miles, second prize; D. H. Bryce's entry of three miles, third prize.

Personals

Lieut. E. V. Deverall, of the Royal Engineers, son of Mr. and Mrs. Charles Deverall, of Toronto, is reported wounded.

Major Walter C. Hyde, of Montreal, has been slightly wounded. He joined in February, 1915, while a student in the department of Architecture, McGill University, and was subsequently awarded his degree in absentia on active service. When in England he was transferred from the 21st Battery, Field Artillery, to the 10th Battery, C.F.A.

Obituary

Mr. Richard Tope, a prominent Hamilton contractor, died at his home in that city recently at the age of 65. He was a native of Devonshire, England, and on coming to this country settled in Hamilton 39 years ago. He was engaged in the contracting business on his own account for 28 years.

Mr. John Brown, who for over forty years had been connected with the James Morrison Brass Company, passed away recently in his 89th year. Mr. Morrison was born in Scotland, but spent most of his life in Canada. He was made president of the Morrison firm fifteen years ago and held that position for two years.

Captain A. T. Rickards, of the Royal Flying Corps, is reported to have been killed on September 13 by a direct hit from an anti-aircraft gun while flying over the German lines. He was born in Bombay, 25 years ago, and received his early education in England, finishing his engineering course at McGill University. Captain Rickards joined when at McGill, obtained a commission with the R. G. A., and later joined the Royal Flying Corps. He was several times mentioned in despatches.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

New Glasgow, N.S.
Town Council contemplate the construction of sewers on Water, Church and Front Streets. Engineer, E. S. Fraser.

Ottawa, Ont.
The Department of Public Works, Dominion Government, contemplate the construction of sidewalk on Sussex St. from Customs House to St. Patrick St. Deputy Minister, J. B. Hunter.

Port Rowan, Ont.
Town Council contemplate the construction of permanent roadway costing $20,000 on Main St. Clerk, W. A. Mabee.

St. Catharines, Ont.
City Council contemplate the construction of relief and outlet sewer costing $70,000 on Carlton Street. Engineer, Wm. P. Near.

Stellarton, N.S.
Tenders will be called and received shortly by the Chairman of Street Commission, J. T. McLellan, for the construction of a watermain for the Town Council.

Winnipeg, Man.
Tenders received until noon, December 3, for the construction of pressure pipe line from Red River to McPhillips Street reservoir, also manufacture and supply of 48-inch premoulded reinforced concrete pressure pipe for the Greater Winnipeg Water District, 501 Tribune Bldg. Specifications, etc., can be obtained at Engineer's office after November 7.

Tenders are being received until November 26 for the construction of tunnel shafts and well at Red River Crossing, also gate house and intake at Waugh for the Greater Winnipeg Water District. Plans and specifications with the engineer, W. G. Chace, after November 7.

CONTRACTS AWARDED

Chicoutimi Parish, Ont.
Riverin & Riverin, Chicoutimi, have the general contract for eleven miles of macadam road costing $135,000 for the Municipal Council.

Fraserville, Ont.
Pettypiece, Ltd., Amherstburg, have the general contract for the construction of silex sidewalks for the Anderdon Township Council.

London, Ont.
The City Council have awarded the following contracts for the construction of sanitary sewers costing $18,000:—Florence Street, W. McCracken, 481 Central Ave.; Eleanor Street, Mitchell & Mohan, care of engineer, H. A. Brazier; York Street, J. McMurphy, 221 Queens Ave.

Port Arthur, Ont.
Chas. Donati, 235 Wilson Street, has the general contract for $8,000 watermain for the Public Utilities Commission.

Sarnia, Ont.
A. Dowswell, care of Engineer, John A. Baird, has the general contract for sewer on Lochiel Street for the City Council.

Stellarton, N.S.
Chas. Mitchell has the general contract for sewer for the Town Council and requires 4,000 feet of 10-inch, 8-inch and 6-inch tile sewer pipe.

Three Rivers, Que.
Hobert, Dugre & Arseneault, Hochelaga Bank Bldg., have the general contract for pumping station and reservoir costing $12,000 for the City Council.

Railroads, Bridges and Wharves

CONTRACTS AWARDED

Malden Township, Ont.
James McGill, Harrow, has the general contract for concrete bridges and drainage work for the Township Council.

St. Alexis, Que.
Laberge & Dufour, St. Alexis, have the general contract for $14,800 concrete and steel bridge for the Municipal Council.

Sarnia, Ont.
Gibb Dock Company have the general contract for a ferry slip for the Pere Marquette, Fort St., Union Depot, Detroit, Mich.

Public Buildings, Churches and Schools

Bella Bella, B.C.
The Methodist Missionary Hospital will erect a hospital costing about $10,000. Tenders will be called shortly for material. Architect, J. A. Benzie, 510 Hastings St. W., Vancouver.

Delia, Alta.
The Municipalities of Delia & Craigmyle contemplate the erection of a hospital. Address, Gilbert Morrison, Delia, or Dr. Crawford, Craigmyle.

Kingsville, Ont.
Town Council contemplate the erection of a chlorination plant. Clerk, Geo. Pearse.

Ottawa, Ont.
A by-law will be submitted for the erection of a $40,000 club house for the Great War Veterans Association. Clerk, N. H. H. Lett.

Peterboro, Ont.
St. Alban's Mission contemplate the erection of a church. Address, C. A. G. Spence.

Point Grey, B.C.
Tenders will likely be called this week for the erection of an addition to dairy building and cottages costing $25,000 for the University of British Columbia, Vancouver. Architects, Sharpe & Thompson, London Bldg., Vancouver.

Saskatoon, Sask.
The High School Board contemplate the erection of a $150,000 addition to collegiate. Chairman, J. F. Cairns.

Sydney, N.S.
The Young Men's Christian Association contemplate the erection of a Y. M. C. A. building at the corner of George and Falmouth Streets to cost about $7,500. Chairman, J. F. Mills, 563 Esplanade.

Toronto, Ont.
St. Matthews Church, First Ave., contemplate the erection of church and rectory. Rector, Rev. C. A. Seager.

Gordon & Helliwell, Architects, 526 Confederation Life Bldg., have filed plans for an additional storey costing $20,000 to hospital for the Women's College Hospital and Dispensary, 125 Rusholme Rd.

Victoria, B.C.
The Children's Aid Society contemplate the erection of a $25,000 home. Address, A. B. McNeill.

CONTRACTS AWARDED

Charlottetown, P.E.I.
Austen Trainor, 118 Kent Street, has the painting contract for $130,000 soldiers' convalescent home for the Military Hospital Commission, Dominion Government.

Chatham, Ont.
The Canadian Contractors & Builders, Ltd., of Brockville, have awarded the contract for a small number of steel sash for the Queen Mary School at Chatham, to the A. B. Ormsby Company.

Coalhurst, Alta.
Mr. Campbell has the general contract for hospital for the Town Council.

Fort William, Ont.
Hacquoil Bros., 149 Emelia St., have the excavating, and Stewart McKenzie, 22 Francis Block, the piling contract for $6,000 collegiate for the Board of Education.

Glace Bay, N.S.
Wm. Farrell has the plastering contract for $25,000 convent and chapel for the Roman Catholic Episcopal Corporation of Antigonish.

Guelph, Ont.
The following contracts have been awarded in connection with the erection of a $3,500 chapel for the Brethren, 200 Cardigan St.:—General contract, Frank Johnson, Central Street; masonry and plastering, J. J. Mahoney, Kint Street; carpentry and roofing, Geo. Scroggie, Woolwich and Tiffany Streets; plumbing, heating and electrical work, Stevenson & Malcolm, Wyndham St.; painting, Reynolds Bros., Quebec Street.

Halifax, N.S.
Frank Reardon, Argyle St., has the painting contract for $4,000 addition to church for St. Malthias Church, Windsor St. The general contractors, Thomson

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Principal Contents

Page

The Latest Word About Activated Sludge

THERE is published elsewhere in this issue a resume of what may be regarded as the latest word in the practice of the activated sludge method of sewage purification. During the last few years the eyes of sanitarians and engineers have been turned toward this system as a possible remedy to the ills attending other and older methods. The experiences of experimental and full-sized plants employing this innovation in sewage treatment have been watched with the keenest interest. In spite of the developments made in England, where progress has been apparent to a greater extent, perhaps, than elsewhere, attention of engineers everywhere has been concentrated on the thorough studies being made in the United States at Milwaukee. Nowhere have investigations been so extensive or so intensively carried out. The sewage testing station of that city under the able direction of T. Chalkley Hatton, its chief engineer, has received the greatest measure of publicity through its endeavors along these lines. Mr. Hatton has been a liberal contributor of information of a vital character relating to sewage disposal methods in general and the activated-sludge system in particular. The latest presentation of such facts is the paper prepared for the annual convention of the American Public Health Association, a body representing, as indicated, the public health interests of Canada and the United States. This paper, on account of its value to all interested in sewage treatment, is largely reprinted in this issue.

Out of the mass of detail relating to plant equipment and operation presented in this paper, the most important, consideration in the eyes of many municipalities is the commercial possibility of the activated sludge method. A possible source of revenue is the sale of dewatered sludge as a fertilizing agent. The dewatering process is subject to further investigation to determine the expense of drying and pressing the sludge into commercial fertilizer. After considering the possible market for such fertilizer, Mr. Hatton is warranted in concluding that with a plant of the size necessary for the city of Milwaukee, the sludge produced by the activated-sludge process can be reduced and disposed of at a profit.

Aside from this commercial aspect, however, the activated sludge method, even in its present state of development seems to possess a full quota of advantages in both cost and manner of operation. The full-size plant at Milwaukee will give, no doubt, some very interesting statistics, and for those municipalities who are laboring under the disadvantages of indifferent methods of sewage disposal, such data will be welcome.

Four Steel Cargo Vessels Being Built at Bridgeburg, Ont.

CANADIAN Allis-Chalmers, Limited, have contracted with the Imperial Munitions Board of Ottawa for the construction of four general cargo freight steamships of 3,500 tons each for the British Government.

These ships, which will be built at the company's shipyard on the Niagara River, near Bridgeburg, Ont., will be two hundred and sixty-one feet long overall, forty-three and one-half feet breadth moulded and twenty-three feet depth moulded, of steel construction throughout and are to class 100 A1, with British Lloyd's Register of Shipping. They will be of the usual bulk cargo type, but with special features adapting them for use during the present war-time conditions, being provided with appliances to protect the vessels against submarine attacks, in addition to being arranged with a view to evade visibility and identification. The steel entering into the construction of these steamers will be furnished by the British Government through the Cunard Steamship Company, and it is understood that a considerable tonnage of this steel will be available for delivery this year, enabling the builders to start operations immediately.

The propelling machinery is to be constructed at the company's large shops at the Davenport Works, Toronto. The main engine will be of the triple expansion type, the size being 20 in., 33 in. and 54 in. by 40 in. stroke and of the surface condensing type. The boilers will be two in number, fourteen feet diameter and twelve feet long, constructed for a working pressure of 180 pounds. They will be fitted, for economical working, with the Howden heated draught.

The coal bunkers will be located under the bridge deck and in the wings of the boiler space and will hold over five hundred tons.

The cargo holds will be three in number, numbers 1 and 2 holds to have one cargo hatch each and the number 3 hold abaft the engine room being provided with two cargo hatches. Each cargo hatch will be served by two independent cargo derrick booms, each of five tons capacity, and each boom with its independent cargo winch. The steam steering engine will be located on the upper deck in a special house abaft of the engine casing. The life-saving equipment will include two 26-foot lifeboats and one 18-foot working boat. The water ballast tanks, three feet deep amidships, will extend the entire length from the collision bulkhead forward to the peak tank aft. The accommodations throughout the ship will be steam heated and the lighting will be by electricity.

St. Marks School, Montreal

St. Marks School is being constructed for the Roman Catholic School Commissioners of Montreal by U. Boileau, Ltd., from designs by Vautrin & Bernier, architects, Montreal. The school is being erected on a site 61 x 116 ft., on Frontenac Street. It consists of a basement and three storeys, of reinforced concrete, terra cotta and brick construction. The main frontage, on Frontenac Street, has a stone base and above rustic brick and Montreal limestone trimmings. The brick is worked out in a series of panels, with a set at each end. The cornices are also of brick. The name of the school—Ecole St. Marc—is in carved stone in the centre of the top floor and is surmounted by a large cross. The two main entrances, in the centre, are of stone, with stone pillars on each side and stone arches. They are approached by stone steps. The school is divided into two sections, boys' and girls', by a terra cotta wall, the doors giving communication being of a fireproof type.

Accommodation is provided in the basement for the furnace, ventilation fans, and coal storage. The ground floor, entrance to which is given by two porches and vestibules, consists of two recreation rooms, toilet rooms, and principal's and waiting rooms. The two other floors are devoted mainly to class rooms, five on each floor, each generally 29.6 ft. x 24.5 ft. On the second floor there is a store room for books and a coat room, and on the top floor a toilet, coat and teachers' rooms. Central corridors divide the various rooms on the two top floors. At each end of the corridor a structural iron fire escape is located.

The interior partitions are of terra cotta and plaster. The floors are of concrete, with hardwood surface. So far as the concrete work is concerned, the complete reinforced skeleton was constructed on the Trus-Con system, using trussed bars and rib bars. The whole of the exterior walls are backed with terra cotta and finished in plaster. The floors in the coat rooms and toilets are of tile, the walls of the latter being of enamelled brick. The stairways are of iron, with slate treads. The roof is laid according to the Barrett specification. At the rear of the site a playground is provided, entrance to the school being obtained by four doors.

The following are the sub-contracts: Brick, National Brick Co., of Laprairie, Ltd.; concrete, Levasseur and Leduc; brick work, Joseph Frenette; ornamental iron, Montreal Architectural Ironworks Ltd.; roofing, plumbing and heating, T. Latourelle & Sons, Ltd.; electric work, Wm. Rochon; plastering, Rochefort and D'Amour; tiling, LePage Marble Works Ltd.; ventilation, M. Chouinard; limestone, T. A. Morrison and Company; reinforcing steel, G. B. Reynolds, Montreal agent of the Trussed Concrete Steel Company of Canada, Ltd.

Architects Have Right to Full Fees

The rights of architects to payment according to scale recognized by the profession in the province of Quebec were upheld in the Superior Court in a judgment recently rendered by Mr. Justice Lafontaine.

Louis N. Audet and Rene Charbonneau sued the Montreal Apartment Company, Limited, for $5,000, this sum being due in payment, on a basis of two and a half per cent. of the cost of construction of a $200,000 building, the plans of which had been prepared by the plaintiffs under the company defendant's instructions. It had been intended to erect the building at the corner of St. Matthew and Dorchester Streets, but the proposal was not carried out, and when the architects made a claim for the regular fees, the defendants pleaded that a special agreement had been made under which the plaintiffs were to be paid only one-fifth of $10,000.

Justice Lafontaine said the proof clearly established that the plaintiffs were engaged to prepare plans of a building that was to cost $200,000, and they were entitled to recover fees on the basis recognized by the profession. Although the defendants had not given effect to their project to construct the building, but had ceded the site to Hebert and Lamoureux, they were liable to pay for the plans the plaintiffs had prepared. Therefore, the court condemned the company defendant to pay the amount claimed, namely, $5,000, and the costs of the action.

Moving pictures illustrating the water powers tributary to Vancouver, B.C.; Calgary, Alberta; Winnipeg, Man., and Montreal, P.Q., were shown at a meeting of the Canadian Society of Civil Engineers, held on November 8 in Montreal. The pictures were prefaced by a brief statement prepared by Mr. J. B. Challies, Superintendent of the Water Powers Branch, Department of the Interior. The film was loaned to the Society by the courtesy of Mr. Challies.

Hydro-Electric Power Development at Cedars, P.Q., Being Extended

Enlargement of Present Power House, and Head and Tail-Race Excavations —Details of Contractor's Plant—Cableway with Movable Tower a Feature

By C. H. Covey *

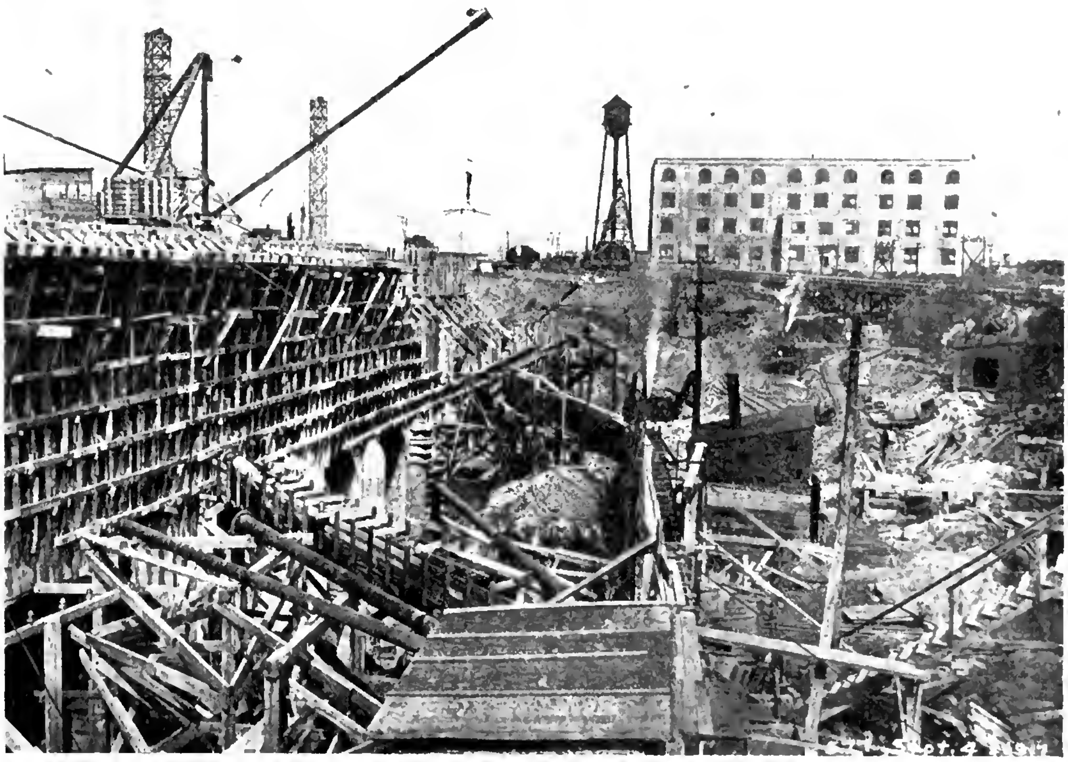
THE second hydro-electric development at Cedars, P.Q., consists of an extension of the present power house approximately 500 feet, excavation of tailrace, and excavation of all headrace that can be done in the dry. The above involves the placing of approximately 65,000 yards of concrete, excavation of 100,000 yards of rock and 200,000 yards of earth.

General Layout of Plant

The concrete is placed by means of concrete towers and chutes, the towers being placed at intervals of approximately 160 feet apart, and 10 feet from the upstream face of the power house. Two Rex mixers of 35 cubic feet capacity are used in connection with the towers; Insley 32-inch chutes are employed for placing the concrete. These towers are built in connection with a trestle, which is constructed parallel to the upstream face of the power house. Stone, sand bins and small cement storage houses are constructed in the trestle at each tower to furnish materials to the mixer. The materials are handled to the mixer by means of 6-yard cars and 25-ton American locomotives.

Stone Crushing Plant

The stone crusher plant consists of one 42-inch x 36-inch Farrel-Bacon style "B" crusher, built by the Jenckes Machine Co., Sherbrooke, Que.; also, one No. 7½ Traylor crusher, gyratory type, and one No. 5 Traylor crusher, gyratory type, used as an auxiliary. The stone is fed into the 42-inch x 36-inch crusher in sizes as it comes from either hand or shovel excavation. After passing through this crusher, it is taken to the No. 7½ crusher by a 6-ply 26-inch rubber covered belt conveyor, inclined at a slope of about 34 in. on 10 ft. The stone passes through the No. 7½ crusher and is then elevated to the screens, all rejections then passing through the No. 5 auxiliary crusher and thence to the stone pile. From the stone pile the rock is handled to a loading bin by a Beatty hoisting engine and a 15-ton stiff-legged derrick, a ¾-yard Lidgerwood clam shell bucket being used on the derrick. It is thence taken, as above noted, in cars over the trestle to the mixer plant. It might here be noted that the crusher plant is a result of the remodelling of the old crusher plant used on the first development, and the layout is possibly not as economical as might be constructed in case a new plant was to be built.



Construction view showing movable cableway tower, transformer house and general layout of pumps used in unwatering power house foundation

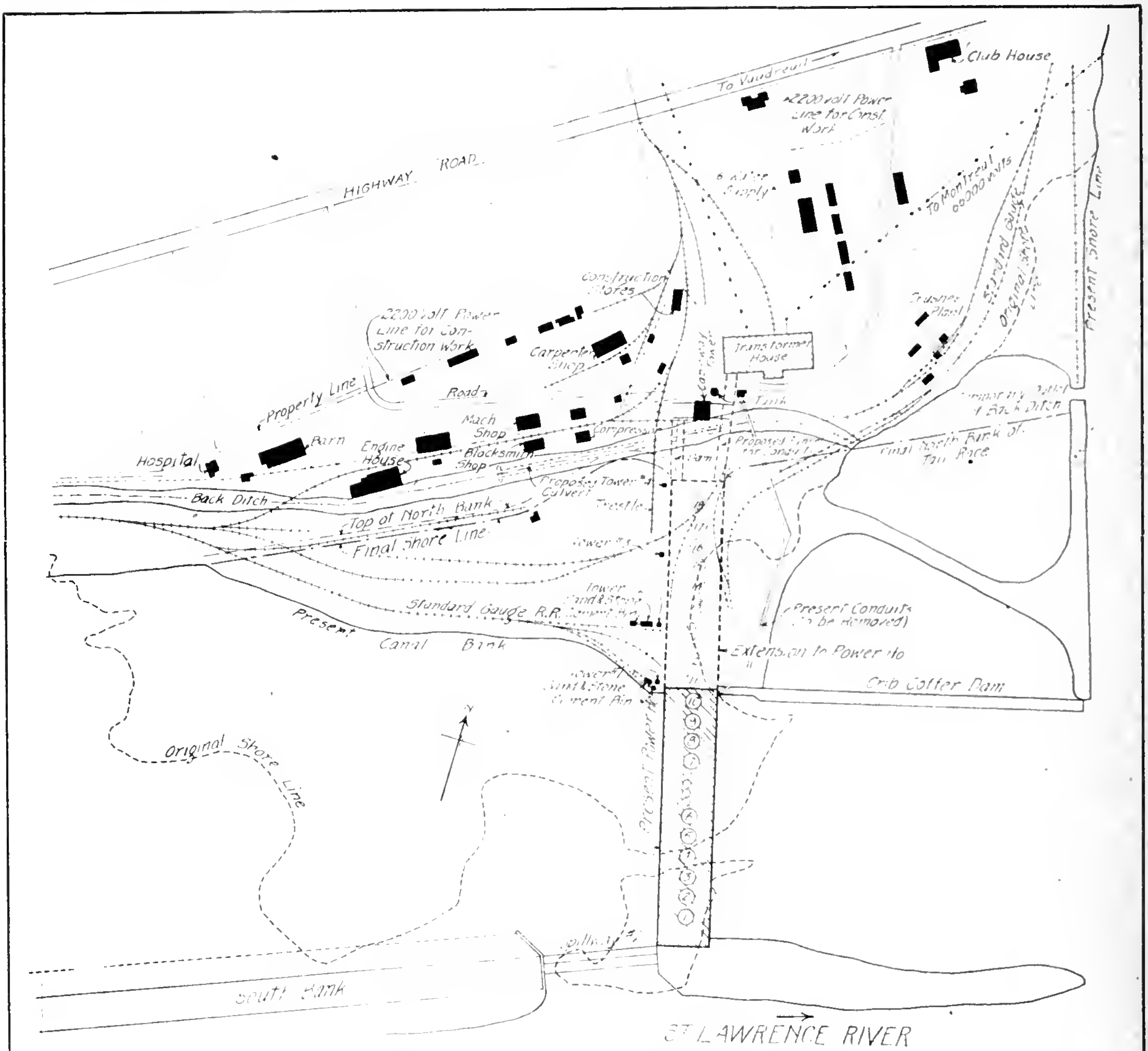
The rock excavation at the power house site is being done by a Marion steam shovel, model 31, with a ¾-yard bucket, which was purchased specially for this purpose. The earth and rock excavation in the tailrace is being done by two model 70C Bucyrus

*Of Fraser, Brace & Co., Ltd., Supervising Engineers steam shovels, each having $2\frac{1}{2}$-yard buckets. 25-ton American locomotives are used exclusively. The compressed air for drilling, etc., is furnished by two Canadian Ingersoll-Rand compressors, each having a capacity of 1,177 cubic feet of free air per minute.

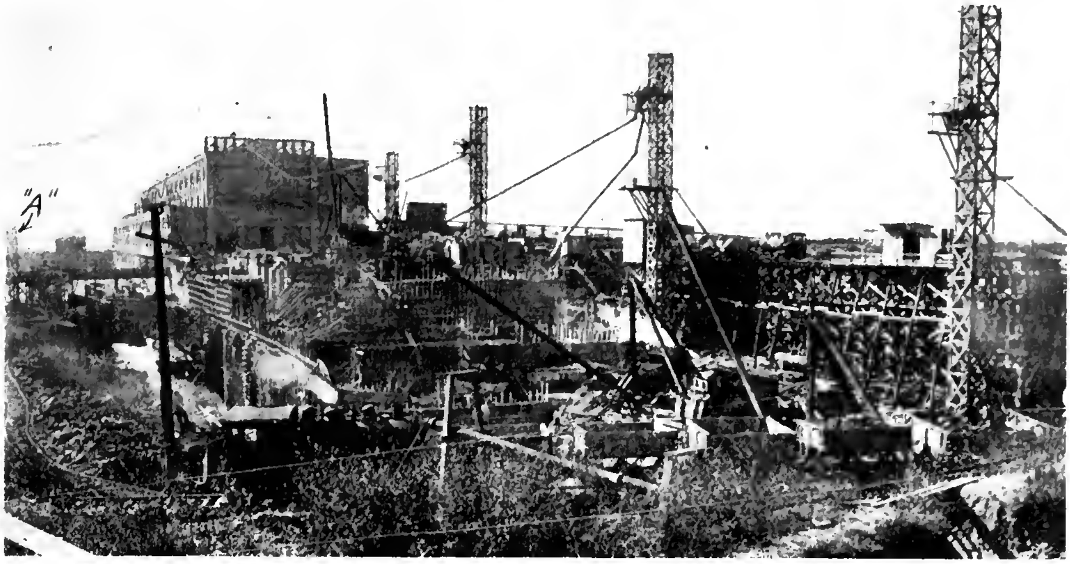
Cableway a Special Feature

A cableway has been constructed with a moveable tower about 150 feet from the end of the finished power house, with a cable which extends from this tower to the top of the present power house and anchored to a deadman beyond the far end of the old power house. The cableway is of a radial type, and was built on the ground out of plant on hand, most of which had been used on the earlier Cedars construction. The cable is carried across the present house by means of trestle bents which allow the cable to move back and forth sidewise. At the end of the power house nearest the extension, the cable is supported on a truck which moves back and forth on a track as the tower moves back and forth.

The cableway can be moved so that it will cover practically the whole area of concrete construction, the tower being moved on tracks by means of a single-drum, 15 h.p. hoisting engine, attached to an endless ⅝-in. cable, which is reaved through two sets of double blocks and run forward to an anchorage. The tower can be moved a maximum distance of 140 feet. The total span of the cableway from center of tower to the extreme end of the present power house is approximately 1,300 feet, but only 700 feet is in the clear, as the remainder passes over the power house already constructed. The tower is 64 feet high, constructed of timbers, 8 in. x 16 in. B. C. fir for the larger members, with 8 in. x 10 in. and 8 in. x 8 in. struts, and 3 in. x 9 in. tie braces. The main cable is plow-steel wire strands, and is $2\frac{1}{4}$ inches in diameter. This is the same cable used on the first development for the dumping cableway. For traversing the carriage a ⅝-inch cable is used and the hoisting cable is also ⅝-in. The engine used on load line is 30 h.p. That on travelling line is 15 h.p., and is the same one



Location of Cedars Power Plant extension and layout of contractor's plant.

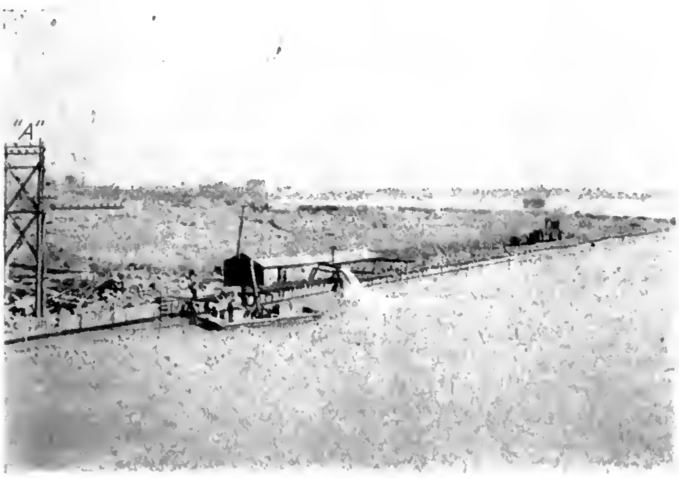


Showing concrete towers and chuting system. Note travelling car supporting large cable on trestle built on old section of power house.

as used on the traveller which was employed in placing concrete for the original work at Cedars. The trucks, which are standard gauge, also came off this traveller. The cableway is only used for handling materials, forms, etc., and is not used to handle any excavation or concrete.

Delivery of Materials

Materials which come in carload lots are consigned to Coteau Junction and come thence to the job via Soulanges Canal on the company's car ferry. The



Cofferdam and tailrace to be excavated. Tower "A" corresponds to "A" of previous cut. The pictures were taken from opposite directions

cement is delivered to the job by barges through the Soulanges Canal to the company's wharf in the Provincial Light, Heat & Power Company's headrace, and is unloaded by means of a gooseneck conveyor, which can be lowered into the barges. The cement is loaded directly onto the conveyor, which carries it into the storage warehouse nearby. This is the same unloader as used on the first development. Coal has been delivered to the job by way of cars which came to Coteau Junction and were handled over the car ferry to the job. On the first development, however, the coal was delivered to the job by barge, and unloaded by means of a derrick and clam shell bucket, which loaded the coal into the hoppers, which in turn dumped the coal into a Hunt automatic dumping car, which carried it to the pile.

A cofferdam has been constructed for unwatering the tailrace for the second development. This coffer dam was built extending from the end of the old cofferdam, about 150 feet from the power house, to the lower end of the tailrace, which connected with part of the coffer left from the original development. It was constructed on the bottom of the tailrace of the first development, which had previously been excavated wide enough to permit this. This cofferdam, after its completion, cut off a considerable portion of the water which was encountered in the bottom of the power house excavation during the earlier stages of the work this spring. The cofferdam is approximately 800 feet long and about 25 feet high.

Personnel

The work is being done by the Civic Investment & Industrial Company, which operates the Montreal Light, Heat and Power Co., the Cedars Rapids Manufacturing & Power Co., and other companies. R. M. Wilson, of Montreal is the Chief Electrical Engineer. G. P. Hawley is Resident Engineer. Fraser, Brace & Co., of Montreal and New York, have been retained as Supervising Engineers. James H. Brace is the firm's resident representative, and the Fraser, Brace & Co.'s organization is directly employed by the Civic Investment & Industrial Co. to do the work.

The next meeting of the Toronto section of the American Institute of Electrical Engineers will be on Friday, November 16, 1917, at the Engineers' Club, at 8 p.m. A series of three papers will be read and discussed:

"A Commercial Method of Taking the Ratio of Current Transformers," by Harry S. Baker, Ontario Power Company.

"Demand Meters," by Perry A. Borden, Hydro-electric Power Commission.

"Relays," by C. W. Baker, Canadian Westinghouse Company.

Summary of Activated Sludge Data

Resume of Conclusions Based on Milwaukee's Experience in Sewage Treatment — Profitable Sale of Sludge in Large Plant

TO those whose faith is pinned to the activated sludge method of sewage purification, the experiences of Milwaukee, Wis., offer rich encouragement. For a number of years, the sewerage commission of that city, under T. Chalkley Hatton, its chief engineer, has been experimenting with this rather new development. Nowhere in America has the process been studied in greater intensity than at the Milwaukee sewage testing station, and the results obtained there augur well for the success of the method in large installations. A resume of the conclusions, based on these investigations, was presented in a paper before the annual convention of the American Public Health Association. This paper, by Mr. Hatton, is largely reprinted below:—

In the activated sludge method as in all other methods of sewage treatment, the character of the effluent required is one of the first questions to decide, for upon it depend the size of plant and the air required to operate it.

Aeration to be Provided Depends on Results Wanted

If the removal of the matters in suspension and the production of a clear effluent are all that is required, less aerating tank capacity and less power should be provided; whereas, if the effluent must be not only clear but well nitrified, the sewage must be given a longer period of contact with the air and sludge and a greater volume of air per gallon of sewage treated must be used.

In an aerating tank having 15 feet effective depth of liquor, 98 per cent. removal of suspended matters can be effected with 0.5 cu. ft. of air per gal. of sewage treated applied for 1 hour, but if nitrates are to be produced in the effluent the same sewage will require from 0.75 to 1.1 cu. ft. of air per gal. applied from 4 to 6 hours.

The reason is found in the fact that the agitation of the liquor by the air separates the solids and colloidal matters very rapidly, but it takes time for the bacteria contained in the activated sludge to convert the ammonias into nitrites and these in turn into nitrates

Should the sewage to be treated be combined with storm water, grit chambers should be installed, of such a design as effectually to exclude all grit from the aerating tanks.

The sewage from an industrial community, collected by either a separate or a combined system of sewers, should be fine-screened before passing into the aerating tanks. This positive statement is the result of the author's observation, covering two years, of the operation of the activated-sludge process under varied conditions at Milwaukee.

Screening Desirable

Grit in the aerating tanks settles to the bottom and rests upon the air diffuser plates, interfering with their efficiency. All industrial sewage carries quantities of waste, fleshlings, pieces of leather, packing-house wastes, large pieces of paper and textiles of many kinds, lime and hair. In the aerating tanks these things form masses of great specific gravity, settle upon the diffuser plates and interfere with their efficiency. If they are carried over to the sedimentation tanks they frequently stop up the sludge draw-off pipes and valves, and thus disturb the continuous operation of the plant. Besides, the decomposition of the organic matter contained in these articles requires large quantities of air, which is a more expensive medium than is required in other forms of sludge reduction. We found in Milwaukee that we could save from 15 to 20 per cent. of air when treating sewage passing a 20-mesh screen, as compared with the same sewage passing a 1-inch grid screen.

Where a purely domestic sewage is to be treated by the activated-sludge process, the author is not so sure that fine screening is necessary. He believes that a 3/16-inch slotted screen is fine enough for any sewage.

Preliminary sedimentation, in lieu of fine screening, is not applicable to the activated-sludge process if the sludge is to be disposed of finally as fertilizer. The sludge from such a tank contains very little ammonia, is hard to handle and mix with activated sludge, and when mixed adds to its weight without adding correspondingly to its value; whereas, fine screenings contain almost as much available ammonia as the activated sludge, can be easily mixed with it in the dryer, and increase the value of the mixture to a proportionate extent.

Attention to Piping Details

After the period of retention in the aerating tank and the volume of liquor to be treated are decided, the tank should be so proportioned as to give the greatest length of flow possible without wasteful use of piping and concrete. Our tanks in Milwaukee are to be 350 feet long and 22 feet wide, the liquor being admitted at one end and removed from the other.

As the piping system of the activated-sludge process is an expensive feature, due attention should be paid to it in the design. All valves should be so placed as to be easily reached, and all air piping should be of such type as to preclude inside corrosion. Iron rust gets into the pores of the air diffusers and reduces their efficiency. Therefore, cast, galvanized, or Sherardized-iron pipe, or lead, should be used to carry air.

In cold climates all air pipes must be made frost-proof to prevent hoarfrost from accumulating on the inside and increasing the frictional resistance to the air. Frost-proofing can be effected by placing the air pipes a few feet under the surface of the liquor in the aerating tanks.

The bottom of aerating tanks should be of saw-tooth, or similar form, with slopes from 1 to 1 to 1 to 1.5, with the air diffusers placed in the gutters. The object is to allow upon the bottom no flat places upon which sludge could rest and become septic.

The air diffusers may be placed in cast-iron or concrete containers—preferably the latter, because they cost less and do not corrode. If cast-iron containers are used, they should receive a good coat of pitch while hot, care being taken to place the diffusers in the containers in such manner as to secure air-tight joints and permit removal and replacement without damage.

What Milwaukee Experience Shows

Sedimentation has received greater study at the Milwaukee testing station than any other feature of the process. It will perhaps be sufficient to state the general conclusions borne out by these experiments.

The running-through velocity should not exceed 3 ft. horizontal per minute.

The detention period may be from 30 to 50 min., according to character of sewage treated.

Vertical-horizontal flow is more efficient than vertical or horizontal.

The effluent must be removed with the least velocity possible and over continuous rather than V-shaped weirs. The latter create cross-currents just where they are most objectionable. Cross-currents must be avoided so far as possible.

The influent must be introduced back of a baffle at least 4 feet below surface of liquor in tank.

The flow should be across the narrow section of the tank. Too long a path of flow tends to pick up the lighter particles of sludge and carry them over with the effluent.

A baffle should be placed back of the effluent weir and extend a few inches below the liquor surface. This is to prevent the fats, match sticks and other light substances, which float upon the surface of the liquor, from passing out with the effluent.

The depth of the tank is not important, except that it shall be sufficient to allow capacity for the settled sludge to be drawn off without abnormally increasing the under-currents near the level of the bottom of the influent baffle due to the suction of sludge passing from the tank.

One Square Foot per 1600 Gallons

An area of 1 square foot for each 1600 gallons of well aerated sewage should be provided. The less the aeration the greater the area required.

The tanks may be either hopper or flat bottom, as desired, and the sewage may be removed by air lifts or hydrostatic pressure. If hopper bottoms are used the slopes must be from 1 to 2 to 1 to 3 to keep the sludge moving toward the draw-off pipe. If the flat bottom is used some apparatus must be provided to remove to a draw-off pipe the sludge settling on the bottom. This may be done by a Dorr thickener or similar device, or by a squeegee mechanically operated from the top of the tank. In the Milwaukee Station the last two mentioned devices have been tried out with satisfactory results. They insure a clean tank, thicker sludge and less tank depth. Returning thicker sludge to the aerating tanks means reduction of air. In localities where deep tanks would add greatly to expense of construction the mechanical devices above mentioned probably would be advisable.

Various Diffusing Media Tried

Several types of air diffusers have been tried at Milwaukee.

Tile are not sufficiently uniform in porosity.

Basswood blocks cut cross-grain ½ in. thick, 2 to 3 ins. wide and 4 to 6 ins. long, give excellent diffusion when first operated. If not treated with a preservative the surface exposed to the sewage deteriorates within a short time through fungous growths. If treated, the diffusion efficiency is diminished. Wood must be saturated constantly in order to keep it in place. If for any reason an aerating tank should be thrown out of commission long enough to allow the wood to dry out, the blocks would pop out of place when the tank was put into operation again. Therefore wood is not applicable to the process.

Perforated pipes give good air diffusion as long as they are kept in constant service and are of such material as to preclude corrosion. The perforations necessarily must be very small and close together. When they are made through galvanized-iron pipe corrosion soon occurs, which stops up the perforations. When the air is taken off the pipes with liquor in the tank, the latter is drawn into the pipes through the perforations by back suction, and when air is returned to the pipes the solids in the liquor which have entered the pipes are forced into the perforations and stop them up. Our experience and that of most other experimenters indicates that perforated pipes as air diffusers cannot be depended upon.

Filtros plates, made by the General Filtration Co., Rochester, N.Y., are porous plates 1½ in. thick, made up of graded sand and burned in kilns under high temperatures. They can be made of any degree of porosity required, are stable in character and are, by all means, the most satisfactory air diffusers we have used at Milwaukee.

Ratio of Air Diffuser and Tank Surface

Ratios of 1 to 4 to 1 to 10 have been used in the United States and England. The latter incline towards the greater ratios. It is the author's opinion that the economical ratio depends largely upon the type of aerating tank used and the character of effluent required.

In a short flowing-through length a ratio of 1 to 4 or 1 to 5 would prove more efficient, thus decreasing the tendency of short-circuiting the passing liquor; whereas in long flowing-through tanks a greater ratio could well be used, because the law of averages is thus better utilized.

The higher standard effluent required the smaller the ratio, for the reasons stated above. The author has determined to use a ratio of 1 to 6 in the Milwaukee plant, where the tanks are 350 ft. long and must produce a high standard effluent.

This factor depends largely upon the character of sewage to be treated and effluent to be produced.

Period of Aeration and Sedimentation

A mixture of domestic and industrial sewage can be well clarified—that is, to contain not more than five per cent. of the suspended solids in the original sewage—in one hour's aeration by using from 0.5 to 0.9 cu. ft. of free air per gallon of sewage treated. To maintain this clarification, however, it is necessary to aerate further the sludge removed from and returned to the aerating tanks. This procedure, however, saves air, because the sludge aerated is only 1/3 to ½ of the total volume of sewage treated.

To produce from the kind of sewage decribed an effluent containing nitrates and 4 to 6 p.p.m. of dissolved oxygen, with a reduction of bacteria from 95 to 98 per cent. requires from 4 to 6 in. aeration. After such period of aeration there seems to be little or no advantage from re-aerating the sludge, probably because it is maintained in prime and active condition by the period of aeration above stated.

The period of sedimentation is connected closely with the period of aeration, assuming the sewage treat ed to be of similar character. A short period of aeration requires a longer period of sedimentation. Well activated or well aerated sludge flocs very rapidly and settles out of the liquor at the rate of 1 in. vertically per minute, whereas poorly aerated sludge flocs slowly; in fact, the finer particles seem incapable of floccing. The principal factor seems to be the area provided, as has already been mentioned. From 30 to 50 min. are sufficient to clarify the sewage, providing the sludge is removed from the sedimentation tank as rapidly as it settles.

Volume of Air Required

Theoretically, it would cost the same to supply an aerating tank 15 ft. deep with 1 cu. ft. of air under 6.5 lb. pressure per gal. of sewage treated as to supply a tank 10 ft. deep with 1½ cu. ft. of air under 4.34 lb. pressure.

If this ratio of air is equally effective in the depths mentioned, the air supply to the 15-ft. tank would be cheaper because the frictional losses through the diffusers and air mains would be about the same in a tank of either depth. If this theory were extended, the deeper the aerating tank the cheaper the air supply. But the less the depth of tank the better the circulation, the smaller the air bubbles and the greater the saturation. Again, it should be noted that the deeper the tanks the greater the volume of sewage treated per acre of disposal plant. This means less concrete construction, air piping, valves, fittings, influent, effluent, and sludge carriers and, last but not least, less area of tank bottom containing the air diffusers. Under average conditions, aerating tanks 15 ft. deep would prove cheaper probably than tanks 10 ft. deep.

The author believes that the Milwaukee sewage can be treated successfully to produce an effluent showing 90 per cent. removal of bacteria, 95 per cent. removal of suspended matter and 72 hour stability, by using 1.5 cu. ft. of air per gallon of fine-screened sewage in a 10-ft. deep tank, and 1.1 cu. ft. of air per gallon in a 15-ft. deep tank, using from 15 to 25 per cent. of activated sludge in the aerating tank; screens to have from 1/8 to 3/16 in. slots.

About 20 per cent. of well activated sludge is all that is required for satisfactory treatment. This percentage is measured in a beaker after ½ hour's settlement, after which the settled sludge contains about 99 per cent. of moisture.

Reduction in Activated Sludge

Up to 1917 our computations to determine the weight of dried sludge produced from the process had been made according to the formula suggested by George W. Fuller, "Sewage Disposal," p. 23. Finding several discrepancies, we determined to make experiments to ascertain the reduction in activated sludge. It was found that 1,640 lbs. of dried fertilizer, containing 10 per cent. moisture, were produced, whereas by Fuller's formula we should have obtained about 2,034 pounds.

In our final plant at Milwaukee we are providing means to produce from each 1,000,000 gal. of raw sewage treated 55,565 gal. of sludge containing 99.5 per cent. moisture, 10,250 gal. containing 98 per cent. moisture, 8,305 lb. of pressed sludge cake containing 76 per cent. of moisture, and 2,076 lb. of dried sludge containing 10 per cent. moisture.

Removing Sludge from Sedimentation Tanks

Several methods have been tried at Milwaukee for removing the sludge from the sedimentation tanks. Where hopper-bottom sedimentation tanks have been used the air lift has been utilized principally. This method has two disadvantages—excessive cost of pumping and producing sludge of high moisture content. It has the advantage of easy control and increased aeration of sludge.

Removing the sludge by means of the hydrostatic head has the advantage of producing a much thicker sludge and a more uniform flow. This last is an important factor in that it prevents to some extent the accumulation of sludge upon the side slopes of the tank, and thus less dissolved oxygen is absorbed in the sedimentation tank. By proper arrangement of valves the sludge draw-off can be regulated satisfactorily, but care must be taken to avoid placing a valve in the draw-off pipe, as it tends to cause complete stoppage of the sludge flow. When possible, a sluice gate should be placed at the outlet of the draw-off pipe.

In every hopper-type bottom used by the author there has been more or less sludge accumulation upon the side slopes of the tank. This sludge becomes septic and absorbs the dissolved oxygen, thus producing a lower grade effluent from the sedimentation tank.

To Overcome Sludge Accumulation

To overcome this tendency flat bottom tanks have been used and squeegees introduced to remove the sludge to a central blow-off pipe. Two types of apparatus have been used with success. The first is what is known as the Dorr thickener, and consists of two or more horizontal arms to which leather scrapers are attached and which revolve around the bottom of the tank, scraping the sludge to a central pipe. These arms are attached to a vertical shaft supported in the centre of the tank and actuated by some power device located at the surface. From long continued tests we have found that the maximum allowable speed of the squeegee arms is about 12 ft. per minute. We have been able to precipitate the sludge successfully by this process at the rate of 1,500 gals. of sewage per square foot of tank.

Another device satisfactorily demonstrated has been a squeegee moving over the bottom of a rectangular tank. The squeegee is attached to a slotted horizontal pipe, which is in turn attached to a vertical pipe fastened to a car running on tracks built upon the top walls of the tank. This apparatus acts in the same way as a vacuum cleaner, the air lift being used to remove the sludge and the car being run by an independent motor with compressor or otherwise, as is learned to be most convenient.

Removes Sludge in Denser Condition

This apparatus has the advantage of removing the sludge in a denser condition than any other method we have used; 98 per cent. of moisture is about the average. In construction and operation it is more expensive than the Dorr thickener.

Either of these last two methods results in lower cost of sedimentation tanks, shallower tanks being required than in the case of tanks of the hopper-type bottom.

The denser the sludge removed from the sedimentation tanks the less area required for both aeration and sedimentation, because with dense sludge returned to the aerating tanks much less liquor has to pass through these tanks to maintain the proper percentage of sludge.

It is therefore the author's opinion that the removal of the sludge by mechanical means will reduce largely the first cost of plant, and will produce a much more satisfactory and uniform effluent.

Dewatering Sludge

The dewatering of sludge may be effected satisfactorily in several ways, depending upon its final disposition. Should the plant be small and local temperature above 50 degs. F., the wet sludge can be dewatered to 75 per cent. moisture in a few days of good weather upon beds of stone and sand, in the same way that sludge produced from Imhoff tanks is dewatered. In colder climates, these drainage beds may be protected by glass buildings similar to hothouses. Sludge containing 75 per cent. moisture or less can be kept under cover without creating an unpleasant odor. During the proper season it can be spread over tillable ground in lieu of manure, in about the same quantity, and will have greater fertilizing value.

It can be dewatered to 75 per cent. water by means of presses of different type, after which the cake can be stored under cover and spread, as said before, upon the ground during the proper season; or it can be pressed, dried and ground to produce a low-grade fertilizer sought for in any market in this country.

The following remarks apply particularly to plants of considerable size producing sufficient sludge to warrant the expense of reducing it to a commercial fertilizer basis.

In Large Plants

The sludge from a hopper-bottom type of sedimentation tanks contains from 99 to 99.5 per cent. of water. If this is allowed to settle in a tank for 5 or 6 hours, the water content can be reduced to 96 per cent., and the volume to one-eighth. This resultant sludge can be dewatered, by any one of at least three kinds of press, to 75 to 80 per cent. of moisture and to one fifty-seventh of its original weight. It can be dewatered further by drying in any one of a number of standard kinds of dryers, to 10 per cent. moisture, and about one two-hundred-and-twenty-third of its original weight.

After drying it must be run through a grinder, of any standard type, to reduce it to sizes applicable to an agricultural seeding machine.

Careful inquiries have been made of manufacturers and dealers in fertilizers as to the market for such a fertilizer and the probable financial return therefrom. We believe we are warranted in concluding that with a plant of the size necessary for the city of Milwaukee the sludge produced by the activated-sludge process can be reduced and disposed of at a profit.

The 6 x 9-ft. Berrigan press, made by H. R. Worthington, Harrison, N.J., can dewater 96 per cent. sludge to 76 per cent. sludge at the rate of about 7 tons of pressed cake per 24 hours.

The 60-plate 3 x 3-ft. press made by the Simplex Ejector Company, Chicago, Ill., can dewater 96 per cent. sludge to 80 per cent. sludge at the rate of 7 to 8 tons per day.

The 5 x 40-ft. Buckeye direct heat-dryer made by the Buckeye Dryer Co., of London, Ohio, can dewater 76 per cent. sludge to 10 per cent. sludge at the rate of 27 tons of dry material per 24 hours by using 1 lb. of combustible to 10 lb. of water evaporated.

The indirect steam dryer of the Smith type can also dewater the sludge successfully, but at what maximum rate we are unable to state, as we never ran it at its maximum.

The one important and unsolved question in the cost of pressing is the cost of the filter cloths or bags, and this cannot be solved except after a year or more of continuous operation. We are basing our estimates on the experience at Worcester, Mass., where Matthew Gault, superintendent of sewers, states in his annual report that it requires 2.2 yd. of 40-in. wide No. 8 duck per ton of dry sludge produced.

Cost of Pressing and Drying

The cost of pressing the sludge is $4.82 per dry ton. This cost includes interest charges at 4½ per cent., depreciation of 2 to 6 per cent., according to character of structure or apparatus, repairs and renewals, filter cloths at $1 per dry ton of sludge, power, labor and all other known expenses.

The cost of drying is $3.93 per dry ton, which includes all charges as above named for pressing except that 10 per cent. depreciation for dryers is estimated, $3.75 per short ton of coal, $0.00424 per kw.-hr. for power, 8 lbs. of water evaporated from 1 lb. of combustible from sludge cake containing 76 per cent. moisture.

A typical analysis of dried sludge, as shown on page of the third annual report of the sewerage commission of the city of Milwaukee, shows 5.1 per cent. of nitrogen as NH_3, 5.3 per cent. fat, 0.5 soluble phosphoric acid and 0.25 potash. In normal times the nitrogen is worth $2.50 per unit. At the present time it finds a ready market at $3.60. Basing the value of the sludge produced upon the lower price per unit, we find our sludge would be worth $12.50 per dry ton, which represents a clear profit of $3.75 per ton.

In the complete report of Pearse and Richardson to the engineering committee of the sanitary district of Chicago and the committee representing the stockyards' interests, dated April 16, 1917, it is estimated that sludge pressing will cost $5.72 per dry ton and drying $2.45 per dry ton, or a total of $8.17 per dry ton.

War Prices

In considering these costs the present high war prices must not be overlooked. These affect also the entire disposal plant for the city of Milwaukee, plans and estimates of which have just been submitted to the sewerage commission. The estimated cost of this plant for treating an average dry-weather flow of 85,000,000 gallons a day is $4,307,000, whereas 18 months ago the same plant could have been built for $3,000,000.

Estimating that one ton of dry sludge can be obtained from 1,000,000 gallons of raw sewage treated, and an average daily dry-weather flow of 85,000,000 gallons, the net cost of disposing of Milwaukee's sewage is estimated as $9.64 per 1,000,000 gallons, of which $4.89 is chargeable to overheads, and $4.75 to operation, renewals and repairs. The 85,000,000 gallons of sewage per day is expected to be produced from a population of 589,000, and the net cost of operation, including overhead charges and maintenance, is 53c. per capita.

Elimination of Odors

There is no offensive odor connected with the activated-sludge process of sewage treatment, but considerable odor may attend improper methods of sludge reduction. Partially dewatered sludge, if exposed to the sun for a few hours, gives off a highly objectionable odor of sulphuretted hydrogen. This odor lasts for a short time only, or until a dry covering is formed.

Sludge placed under cover and not exposed to sun or wind gives off little odor.

When the sludge is dried through a direct heat dryer, a very offensive odor is thrown off with the hot gases of combustion. To overcome this, the gases must be run through a dust box, thence through a condenser, and the insoluble gases escaping from the latter should be discharged into a furnace immediately under the fire grate.

Flies, insects and worms do not infest the treatment plant, even during the early fall when they are so prevalent in nearly all other types of disposal plants.

The foregoing statements and conclusions have been made as the result of observations and studies of the operation of the sewage testing station at Milwaukee during three years; the last half of the study has been almost exclusively confined to the activated-sludge process.

Activated Sludge Process and Percolating Filters

The only process known to the author which can produce an effluent comparable with that from percolating filters is the activated-sludge process, which, when developed to the extent possible and very probable within the next decade, will doubtless supercede the filters. There are many advantages in this new process which must be considered, among which are small area, lower first cost, and final disposition of the troublesome sludge.

As compared with percolating filters treating a maximum rate of 3,000,000 gallons per acre under favorable climatic conditions, the activated-sludge process can treat 10,000,000 gallons per acre under the most unfavorable climatic conditions.

The first cost of construction is higher for the percolating filters than for the activated-sludge process, and little difference is expected in the cost of operation.

Metcalf and Eddy in Volume III., "American Sewerage Practice," give the following figures as to the cost of construction and operation of several important percolating filter plants: At Gloversville, N. Y., the cost was $58,455 per 1,000,000 gallons, exclusive of roofing. Operating cost in 1914 was $5.92 per 1,000,000 gallons. At Fitchburg, Mass., the cost was $59,650 per million with operating cost when treating about 2½ millions about $12.00 per million.

The average cost of nine of the most modern plants in the United States is given as $47,000 per million gallons. (These costs are exclusive of engineering). E. J. Fort, of Brooklyn, estimates the cost of overheads and operation for a plant treating 30 million gals. will be $9.50 per million gals., exclusive of the final disposition of sludge. Mr. Ulrich, city engineer of Reading, Penn., gives the operating cost of the Reading plant as $9.13 per million in 1912.

Cost of Milwaukee Plant

The Milwaukee plant, as designed, is estimated to cost $44,000 per million, exclusive of engineering and pumping, and $4.75 per million gals. operating cost. This first cost embraces prices for labor and material which did not prevail when the percolating filters above referred to were built.

Mr. E. E. Sands, city engineer of Houston, Tex., has just completed an activated-sludge plant (exclusive of sludge disposal) to treat 12 million gals. at a cost of about $24,000 per million, and expects to install the sludge disposal features for $40,000, the balance of his appropriation.

The high nitrogen content in the sludge produced from the activated-sludge process warrants the expense necessary to reduce it to a fertilizer basis, and thus the sludge problem is solved without nuisance.

The absence of odors, flies and other insects is no small advantage. Freedom from odors frequently enables the engineer to eliminate long expensive outfall sewers. The small loss of head through the process frequently obviates pumping, as is so often required in the percolating filter process.

Cost of Power

Throughout many discussions by engineers of this new process the cost of power has been one of the stumbling blocks. In a small plant treating less than five million gallons per day the cost of producing the power might prove too expensive, but where larger plants are under consideration power can be produced easily for less than 1c. per horsepower-hour. Such a cost will place the cost of operating the process upon an equality with that of the percolating filters.

However, local conditions can determine best which of the two processes should be installed, but the author contends that such determination should be made only after a thorough study of the merits of the two processes, and not from the point of view that one process has been operated successfully in many places, whereas the other is still more or less in an experimental stage. If this attitude were adhered to in the industrial field, very little progress indeed would be made.

Solving Engineering Problems by Popular Vote

OCCASIONALLY a city settles its engineering problems by a vote of the people. "Municipal Engineering" cites a couple of instances and comments upon them as follows:

An extreme example of this particular kind of folly occurred in a West Virginia city a few years ago, when the city called an election at which the people voted their choice between two contending systems of water purification. The experts disagreed, so the utterly inexpert, plain people were called on to decide by their votes.

Recently property-owners in an Oklahoma city decided on the type of pavement to be constructed. The proceedings were delightfully informal. The members of the city council and the property-owners assembled in the court room. Standing room was at a premium. The mayor presided, and announced as the object of the meeting the making of a choice of paving materials.

Each sales engineer, representing a paving company, was allowed fifteen minutes in which to explain the merits of his product. Five men spoke for a total of one hour and fifteen minutes, and the assembled freeholders took it all in "profound as prairie dogs."' Then they voted, and the cheapest pavement—cheapest in first cost—was an easy winner.

Ninety-nine times out of one hundred the people, if given a chance, will vote for the thing that costs least to start with. This is only natural, and might be expected, for the first cost is the only thing that means anything to the voters. Since the thing that is cheapest to begin with is not always cheapest in the long run, the folly of letting the people vote on such matters is evident. The principle, moreover, is absolutely wrong, as such questions are highly technical and should be decided by trained experts, acting for the people who are incompetent to decide for themselves.

St. Joseph's Novitiate

A Steel-framed, Brick and Tile Faced Building Under Construction Near Toronto—Water and Sewerage Systems

THE illustration herewith is a progress view of the St. Joseph's novitiate building which is now in course of erection some distance outside the city of Toronto. This is to be the home of the novices during their probationary period before they take the final vows of the order of the Sisters of St. Joseph. The site selected for the building is almost ideal. It is on an eminence not far from the shore of Lake Ontario, and there is but one spot on the lake front where the elevation is higher. It faces rather in a westerly direction, being in alignment with the Kingston Road, from which it is approached by a long driveway. Communication to and from the city is easy; a few miles ride over an excellent highway gives access to King Street.

Wings To Be Added

The structure will ultimately include two wings—one at either end. These are to be added at a later date, when circumstances render it advisable, as will also a chapel which is to be erected as a wing extending from the centre of the building in the rear. These

St. Joseph's Novitiate under construction.

additions will give the whole structure somewhat the shape of the letter E. However, when the present main building—209 feet long and four storeys in height—is completed, it will present quite an imposing appearance. It is faced for the most part with red brick, but around the main entrance a considerable amount of stone work has been used. The entrance vestibule has been faced with Indiana limestone and the finials at the gable line are of the same material. The ornamental windows in the centre portion of the building add to the architectural effect.

Two Hundred Rooms

A flight of steps leads from the driveway to the entrance vestibule on the main floor of the building. On this floor are the portress' room, office, music rooms, parlors, novices' and postulantes' rooms. The floor below this, since it is above grade, can scarcely be considered as a basement. It contains the kitchen and stores, together with refectories, recreation rooms and two class rooms. On the second floor of the building there are cells which provide sleeping accommodation for the sisters, also a chapel and an infirmary. The chapel is in the centre of the building over the entrance vestibule and extends through the second and third floors. The remainder of the third floor is taken up with cells. At the rear of the building, a verandah with balconies at each floor extends 180 ft. of its length. This verandah is carried on sixteen brick piers and its three floors are of concrete. At each end of the building is a stair well providing communication between the floors. There are over two hundred rooms in the building, and 365 windows.

Steel Frame, Brick and Tile Faced

The building is of steel frame construction with brick and tile walls. Laterally there are 19 bays, each about 16 ft. wide. There are three longitudinal bays—two bays 18 ft. 3 in. wide and one bay 10 ft. 6 in. wide in the centre. Twelve-inch I-beams support the floors over the 18 ft. 3 in. spans, while a 7-inch I-beam is used for the 10 ft. 6 in. span. H-section columns are employed in the structure. These are 8 in., 6 in., 6 in., 5 in. and 5 in. respectively, from the ground floor up to the roof. The walls are of Denison interlocking tile with an outer 4½ in. brick facing. On the first two storeys there is a 22-inch wall, on the next an 18-inch, and on the top storey, 14-inch. The walls carry the ends of the I-beams which support the floors, and a 22½ in. x 22½ in. bearing surface is provided, pilasters being used on the upper storeys. The floors are of timber joist construction laid with ⅞-inch maple and will be finished in hardwood. Steel trusses support the roof of the building, which is covered with slate. The foundations are of concrete.

Water and Sewerage Systems

Efforts have been made to provide the new novitiate with all the conveniences that might be found in the city. It will have its own water system, the water being pumped from a number of springs a few hundred yards distant to a tank which will supply pressure to the building. There will also be a system for the collection and distribution of rain water, so that soft water may be obtained when required. For the disposal of the sewage, a septic tank, 40 ft. x 30 ft. x 12 ft., will be installed, and the effluent will be discharged through the surrounding land by means of weeping tile. About 13 ft. of this will be laid for each person, corresponding to the capacity of the building. Adjacent to the main structure, a brick boiler house has been erected which feeds the heating system and supplies hot water for other purposes within the building. This house also contains the laundry and ironing room. It has a brick chimney 96 ft. in height.

Underground Storage

A useful adjunct to the new institution is a root house, which has been provided for the storage of vegetables, etc. This house has been constructed underground at the rear of the main building, to which it is connected by a passageway. It has also an entrance from the outside. The roof is 2 feet below ground, and ventilation is obtained through two vents in the floor and three in the ceiling, so that fresh air is brought from the outside. Four rows of weeping tile have been laid underneath the structure to thoroughly drain it.

Work on the St. Joseph's Novitiate building was commenced in September, 1916, and it will probably be ready for occupation by March of next year. Wickett Brothers, of Toronto, are carrying out the general contract. The methods used in the construction of the building are standard and there are no features that may be described as unusual. The water supply necessary for the work was obtained from the springs mentioned above, being pumped to a 4,000 gallon tank by a gasoline engine.

The sub-contractors and suppliers of material are as follows: Denison interlocking tile, Sun Brick Co., Toronto; brick, Bell Bros., Toronto; boiler, John Inglis Co., Ltd., Toronto; lime, Ontario Lime Co.; stone and cement, Smyth & Ryan, Toronto; steel, McGregor & McIntyre, Toronto; lumber, John B. Smith & Sons, Ltd., Toronto; plumbing, W. J. McGuire, Ltd., Toronto; plastering, E. J. Curry, Toronto; electrical work, Martin Nealon, Toronto. Mr. A. A. Post, of Buffalo, N.Y., is the architect.

Road Failures Often Due to Poor Judgment

Considerations Governing the Choice of the Various Types of Construction—From Paper Before Washington State Association of Engineers

By L. V. Edwards

THE failures, during the past few years, of many different types of road surfaces that were thought—at least by those who authorized their construction—to be practically permanent has aroused alike the road official and the taxpayer. On account of such failures many charges are being made of dishonest work on the part of the contractor and incorrect specifications and inefficient supervision on the part of the engineering forces. There may be some truth in these accusations, but it is my opinion that at least as many failures have resulted on account of poor judgment being used in selecting the type of surface as in dishonest construction and inefficient supervision. In other words, as much money is being wasted by those officials who are responsible for the type of road constructed as there is by those charged with the construction.

To illustrate this point: Suppose a road should be constructed of nice, fresh eggs. Suppose that the specifications required that each egg be tested to ensure the proper quality, and that they should be hand-placed, on a properly-constructed foundation, to the desired crown and grade. Also suppose that in the construction the specifications were enforced to the very letter, and that everything was done that was necessary to make a nice, smooth, well constructed highway. Then suppose the finished road were thrown open to traffic and the first vehicle to pass over it was a 12-ton truck, travelling at a speed of fifteen to twenty miles per hour. It is quite evident that there would be some "signs" of failure; and, what is more, no one would be surprised at the result. The failure in this case would not be due to poor construction, but to poor judgment in selecting a type of surface that was not strong enough to carry the traffic. This illustration sounds ridiculous, but its equivalent is being done every day. We continue to place thin crushed rock and water-bound surfaces on roads that have from 200 to 600 motor vehicles per day, when it is a know fact that such surfaces will not stand a motor traffic of more than 50 to 100 vehicles per day, regardless of the care used in their construction. Yet when these surfaces fail we express surprise and indignation and accuse somebody of being incompetent or crooked. The fact of the matter is that these roads are not strong enough to carry the traffic put upon them.

Snap Judgment in Selecting Roads

Before taking up a discussion of some of the points that should be considered when selecting a type of road it might be well to mention a few of the things that are sometimes done that do not aid sound reasoning when trying to decide upon the proper method to follow. As far as I know, road-building is the only kind of business in which great weight is given to snap judgment. Many highway boards, apparently without question, act upon recommendations passed by some chamber of commerce or farmers' organization, when probably the only thing considered was the item of first cost. It is an unfortunate fact that there are so many men, particularly among automobile drivers, who think they are qualified to decide offhand the kind of treatment that should be given to any class of road. As a result of this supposed knowledge by so many there is much free advice given, and damage is done by not recognizing the fact that in the majority of cases the advice is worth no more than it cost to get it.

Very often a type of construction involving the expenditure of thousands of dollars is selected upon the recommendation of some person who is interested in a patented pavement, or of someone who is interested in selling a certain kind of material, or by the board having the power of selection mistaking its lack of knowledge of the existing conditions and types of surfaces for great wisdom. I do not know of a better way for snap judgment to be formed by a committee of inexperienced men than for them to go on a two or three days' tour of inspection of the streets and roads in and around a big city, under the guidance of a skilled person who is interested in promoting some particular type of surface.

Undue Prejudice

The average person is inclined to be hasty in his opinion, and is often unduly influenced by his impressions. If he has recently been taken over a considerable mileage of one type of surface that is in fine condition and is then driven over another kind that is in a bad state of repair, he is, upon this evidence alone, likely to become strongly prejudiced against the one and favorable towards the other.

I remember having talked with a gentleman who had recently returned from an inspection trip of the kind mentioned. He had formed a very high opinion of a certain type of construction and a very poor opinion of one of the best-known types. When I tried to explain to him that the type of construction he was so enthusiastic over had not been in use more than ten years, and that it was proving to be unsatisfactory in a number of places where it had been laid, and that the pavement he was condemning so severely had withstood the traffic of Fifth Avenue, New York City, which had a probable daily traffic of 14,000 vehicles, for a period of seventeen years, and that there were several cities where it had been in service over a period of twenty-five years, he concluded that I was prejudiced and was greatly exaggerating the truth, for had he not seen the condition of the two types of pavement with his own eyes?

There is no question but that a great deal can be learned in a short time by making an inspection trip over several different types of pavement, and the cost of making such an inspection may be an infinitesimal amount compared with the saving resulting from the knowledge gained. But one must be very careful or false impressions will be made. For this reason I believe that these trips should be made at the expense of the political subdivision represented, and always in company with an experienced engineer.

Serve Traffic at Minimum Cost

When any highway improvement is undertaken the object to be sought is to select the type of construction that will serve the traffic to be carried at the lowest annual cost per unit. To thoroughly understand that statement it must be kept in mind that the three main items in the total cost of a road surface are first cost, maintenance cost, and interest on the money invested. These are all variables, and, with the exception of the interest rate, depend entirely upon local conditions. The problem, therefore, resolves itself into a study of local conditions, which, with a knowledge of the characteristics and the traffic-resisting qualities of the several kinds of surface, makes it possible to select that type of construction which, at least approximately, will serve the traffic at a minimum cost.

When considering the type of road to be built there is no question but that in many cases too much weight is given to the first cost of construction and not enough to maintenance cost and other considerations. The tendency has been to select the cheapest road, with the hope that maybe it would prove to be the best. The great demand for as much mileage of improved highway as it is possible to get with the amount of money available, even though it may be second-rate, has undoubtedly had much to do with the selection of unsuitable surfaces. Many, however, are now beginning to realize that it is the poorest sort of economy to spend in constructing a surface that immediately fails, thus requiring excessive maintenance work if the highway is to be kept in passable condition, two-thirds as much money as would be required to construct a different kind that would have sufficient strength and durability to carry the traffic with only a small annual cost for maintenance.

As has just been pointed out, for economical results, maintenance, interest, and the volume of traffic must be considered. It is evident, therefore, that there is no type of construction that will give economical results under all conditions. A type of road costing $15,000 per mile may be more economical in one case, while in another case traffic might be so light that $1,000 per mile would be the proper amount to expend. If all the different roads in a county were surfaced with the proper type, in each case, to give the least annual cost per unit of traffic, there would necessarily have to be many different kinds in use to satisfy the variable conditions. There would probably have to be a large mileage of earth, gravel, and macadam, as well as of the more durable types, such as bituminous concrete and brick. A point to be noted is that with such a system the annual cost per unit of traffic would be the same on the earth or gravel as it would be on the bituminous concrete or brick.

Local Conditions Must Be Studied

It has already been intimated that local conditions are the important things that must be studied before it is possible to decide upon the correct type of construction in any given case. A study must be made of the climatic conditions; the effect of moisture and frost action on the subgrade, in other words, drainage; the quality and availability of road-building materials; the kind and amount of traffic, etc. These not only have a bearing on the first cost and, therefore, the selection of the proper type, but also affect or control the design of the type that is to be used.

At this point I wish to emphasize the importance of a thorough knowledge of subgrade conditions when designing a surface for a given road. Highway engineers probably commit more sins on account of insufficient knowledge on this one point than on any other part of the work. One of the things that must be studied to obtain a proper knowledge of the conditions is the nature of the soil in the subgrade from one end of the improvement to the other. This would probably involve a determination of the approximate amount of mineral matter present and the effect that water and frost would have on the material. The designer must also know the topography of the locality and the laws governing the flow of both surface and underground water to be able to know what effect these will have on the finished roadway. He must also know the supporting power of the subgrade—at least at the points where it is weakest—in order to design a surface that will be sufficiently strong to carry the road over these places. The supporting power of any subgrade, no matter what care has been taken in its preparation, is a very variable quantity. It is, therefore, not to be wondered at that when miles of pavement, having a uniform thickness, which means also uniform strength, are placed on this unequal support, parts of the pavement fail while other parts remain good. Think of the money that could be saved if engineers knew enough to vary the thickness of the surface during construction, within the proper limits, to take advantage of this unequal supporting power.

Knowledge of Traffic Necessary

Traffic is one of the main factors that must be considered in the selection of a type of surface. The importance of the need of knowing at least the approximate amount of traffic that our highways are carrying cannot be overestimated. It does not seem reasonable that one would undertake to build a structure to perform a certain service when he knew nothing, or practically nothing, about the nature of the service to be performed. This, however, is being done every day in highway work. Owing to the large number of variables that influence the volume of traffic that any highway may have, a considerable amount of investigation has to be made before it is possible to make a reliable estimate of the daily or annual traffic that any road may have during its life. Fortunately, however, to serve a good purpose in determining the type of road to construct, it is not necessary to have an exact knowledge of the traffic to be served. If the traffic were estimated within 50 per cent. of the correct amount it would be a great deal better than knowing nothing about it at all, as is so often the case at the present time.

The best way, of course, to find out the traffic any road is carrying is to make a count, or take a traffic census. To get absolutely correct results would require that a count be made every day in the year, but sufficiently reliable results can be obtained if the count is taken for ten to fourteen hours every third, fifth, or thirteenth day throughout the year, or at less frequent intervals if the importance of the road does not justify the more careful count. A splendid idea of the relative importance of the several roads in a county can be had by taking even one count, extended over a period of two or three days simultaneously, on all the roads. Even a very little traffic data, if studied in connection with other things, will often make it possible to predict, with a reasonable degree of accuracy, what the traffic will be and give a good idea of the rate of increase. Some of the things to be considered which affect the volume of traffic are: Population; assessed valuation of the property; the nature of the agricultural work; the number of automobiles and other vehicles in use; and whether or not the road is a section of a trunk line highway. The probable rate of increase in traffic must also be considered. For example, the volume of traffic on a given road does not increase directly as the tributary population increases, but as the square of the increase in population, other things being equal. This means that when the population doubles, the traffic on the highway will be quadrupled.

Sometimes the traffic on a highway increases several hundred per cent. immediately after it has been improved. This is to be expected if the tributary and parallel roads are in poor condition. The traffic on the first road will tend to decrease when these tributary roads are improved.

Other Things to Consider

When making comparisons of two different types of surfaces for the same highway several things must be considered besides the first cost and annual maintenance cost. Suppose, for example, that a bituminous concrete surface is being compared with a water-bound macadam surface (assuming, of course, that it would be possible to maintain a macadam surface where the traffic was heavy enough to justify a bituminous concrete surface). Even though the unit cost of traffic might figure the same for the two types, the superior degree of service furnished by the bituminous concrete would be a point in its favor. Also the less rolling resistance to traffic, less damage to vehicles, particularly the tires of automobiles, and its appearance would all be points in favor of the more costly type, while the water-bound macadam would have the advantage from the standpoint of better foothold for horses. Another thing must be considered when making the comparison between the two, and that is the value of the pavement when it has reached the stage where it is necessary to reconstruct the surface. This residual value, as it may be called, may be as much as 75 per cent. of the original cost in one case, while in the other it may be practically zero. To illustrate: Suppose a bituminous concrete surface were originally constructed of 3 in. of bituminous concrete on a 7-in. portland cement concrete foundation. At the end of twenty years, say, the bituminous portions of the pavement may have to be reconstructed, in which case it probably would be necessary only to clean the bituminous surface, rip it from the concrete foundation, reheat it, adding enough bituminous cement and mineral aggregate to give it the proper quality and enough volume to allow for the loss in wear and replace on the old concrete foundation. The pavement would then be good for another twenty years. It is evident that the cost of this second construction would amount to only a small part of the first cost.

For a proper selection of the type of road surface, therefore, the following things must be known to at least a fair degree of accuracy:

1. Local conditions as they affect the design and first cost.

2. The amount of traffic to be accommodated by the highway.

3. The characteristics, such as appearance, ease of traction, foothold for horses, ease of making repairs and cleaning, durability (meaning the power to resist the action of the elements), and the traffic-resisting quality of the various types of road surfaces.

Problem Essentially an Engineering One

Experienced highway engineers who know the life history of the various types of construction and their behavior under different climatic and traffic conditions are able to predict with a reasonable degree of accuracy the behavior of any type of construction when subjected to a known set of conditions. It is the adjusting of the knowledge of the different types to the local conditions such that traffic will be served at the lowest unit annual cost that solves the problem. This problem is essentially an engineering one, and is worthy of the most conscientious efforts of the best-trained engineers. To emphasize this point, I wish to quote from an article by Mr. Rodman Wiley:

"The day will come," he says, "and it should not be far distant, when the taxpayers will appreciate the fact that the roads are their property; that the same care should be given to the expenditures of such funds as is given to the management of their own private affairs. When they are ill, they consult a doctor; any legal problems are entrusted to a lawyer; and for the salvation of their souls they usually accept the advice and recommendations of a minister of the gospel. When they employ labor, it is their aim to secure a man who is familiar with the work he is supposed to perform, and yet when it comes to road affairs they eagerly listen to any demagogue who has pet theories concerning road-building, forgetting that there are accepted standards for road work the same as for building railroads, steam engines, or office buildings. . . .

"When the people realize that the building of roads, and especially the selection of the type of road, is a high-class engineering problem, and that such matters should be entrusted to high-class highway engineers, amply paid, the same as men in other professions, then, and only then, will the taxpayers be properly safeguarded and will we experience a wise and economical expenditure of road funds."

An interesting report has just been made to the International Joint Commission relating to official reference re Lake of the Woods levels. This report is in four separate volumes, and is submitted by the consulting engineers, Arthur V. White and Adolph F. Meyer. The volumes consist of (a) a text of 314 pages, with numerous illustrations; (b) a bound volume of 144 plates; (c) a volume of tables, including meteorological data on the Lake of the Woods watershed, water levels, discharge tables, miscellaneous tables, etc., and (d) a watershed map of the Lake of the Woods, mounted on cloth and bound in book form. All four volumes are bound in the regular blue cloth binding of the department.

The International Joint Commission is composed of three members from Canada and three from the United States, with a secretary for each group. The Canadian members are: C. A. Magrath, chairman; H. A. Powell, K.C., and P. B. Mignault, K.C.; Lawrence J. Burpee, secretary. The United States members are: Obadiah Gardner, chairman; James A. Tawney, and R. B. Glenn; Whitehead Kluttz, secretary.

Mainly Constructional

East and West—From Coast to Coast

The building permits issued for the month of October in the city of Regina, Sask., total $42,800, as compared with $15,400 in the same month last year.

The building permits issued in Chatham, Ont., for the month of October amount to $43,950, which is an increase of $26,350 over the same month last year.

The Canadian Northern Railway recently made application to City Engineer Fellowes of Vancouver, B.C., for a permit to construct train sheds on the False Creek terminus site, at a cost of some $170,000.

On Nov. 6 a special party of government representatives and members of the Toronto and Hamilton Highway Commission witnessed the completion of the new highway, when the last slab of concrete was laid, east of the crossing of Etobicoke Creek.

Building permits issued in Chatham, Ont., for the month of October total $43,950, showing an increase of $26,350 over the figures for the same month last year. The total for the ten months of 1917 is $350,272, an increase of $75,073 over the corresponding period in 1916.

The building permits issued in Vancouver, B.C., for the month of October number 71, and are valued at $233,975, as compared with 41 in the same month last year, valued at $394,085. The total for the first ten months of the year is 477, valued at $656,885, while for the corresponding period in 1916 there were 377, valued at $2,025,829.

Montreal's building permits for October number 169, and are valued at $227,033, which compares with 171 permits, at a value of $352,924, in the same month last year. During the first ten months of the year there were 1,469 permits issued, at a value of $4,079,698, as compared with 1,669, valued at $4,139,934, in the corresponding period last year.

The Union Cement Company contemplate a considerable extension of their operations at Owen Sound, Ont. They propose equipping the old Sun building with a plant having a capacity of 2,500 barrels, to be ready for operation in 1919. There are difficulties as regards obtaining the necessary steel machinery, owing to the condition of the steel market, but the company is negotiating the purchase of second-hand plant.

The Toronto City Council have granted permission to the Toronto Harbor Commission to sell 139 acres of land in the Ashbridge's Bay industrial area. This land has no dockage facilities or riparian rights. Previously the intention had been merely to lease the land. The proceeds of the sales are to be invested in the securities of the commission, so that the interests of the bond-holders will be protected. Four acres of the land will be sold to the Imperial Oil Company, at $15,000 an acre.

Hon. F. B. Carvell, Minister of Public Works, recently visited the city of Toronto and made an inspection of the harbor improvement works. He expressed pleasure and surprise at what had been accomplished, and he stated that, while it might be necessary to curtail some portions of the work or defer them till after the war, no work would be stopped that could be regarded as in any way helpful to the prosecution of the war.

The Council of the town of Cobourg, Ont., are submitting a resolution to the Ontario Government in regard to the establishment of a new road between Port Hope and Cobourg. They point out that the present toll road is intersected by three railway lines, and on this account there is considerable accident hazard for vehicular traffic. They urge that a new road should be built between these towns traversing that portion of the Township of Hamilton south of all of the three railway lines, as a portion of the provincial highway between Toronto and Kingston.

Building returns from the City Architect's Department in Toronto are quite encouraging. The permits issued during the month of October number 513, and the estimated cost of the work involved is $786,225, while for the same month last year there were 436, valued at $496,148. For the first ten months of the year the total value of permits issued is $6,375,079, as compared with $5,504,797 in the corresponding period in 1916. The increase in the demand for dwellings is indicated by the fact that during the ten months of 1917 permits were issued for the erection of 810 houses, at a value of $2,050,095, while the total for the whole of the preceding twelve months reached only $1,813,900.

Personal

Lieut. Jack Newcombe, of Toronto, a graduate of S.P.S. in 1916, is returning to Canada on leave. Since last February he has been serving with the 12th Field Company of the Royal Engineers.

Mr. Frank D. Adams, Ph.D., D.Sc., F.G.S.A., F.R.S., dean of the Faculty of Applied Science, McGill University, and Mr. W. Hodgson Ellis, M.A., M.B., LL.D., dean of the Faculty of Applied Science and Engineering, Toronto University, have been elected honorary members of the Canadian Society of Civil Engineers. These appointments fill the vacancies caused by the deaths of Earl Grey and Sir William C. Macdonald.

Capt. J. Roy Cockburn, formerly professor of descriptive geometry at the University of Toronto, recently had a unique experience while in Palestine, where he holds command of a unit of the Royal Engineers. He and two brother officers, who had gone to look over the land in the vicinity of Beersheba, were detained as suspected spies, as they had neglected to carry their identification discs on their persons. Capt. Cockburn's appearance tallies closely with the description given of a famous German spy, and, as a result, he was kept under particularly close supervision. The arrival of a high army officer who was able to identify them obtained the release of the prisoners. Capt. Cockburn, who is a B.A.Sc. of the Faculty of Applied Science and Engineering, trained in the C.O.T.C. and the 170th Battalion. He went overseas in September, 1916, and reverted to the ranks in order to reach the front. After serving with another Toronto battalion for four months he was transferred to the Royal Engineers. On August 3 last he was sent to Egypt and promoted to a captaincy.

Obituary

Lieut. K. F. Keeping, reported to have died of wounds, was a graduate of science at McGill in 1914. Prior to enlisting he was employed on survey work for the government in British Columbia.

Lieut. Frederick J. Anderson, formerly city engineer of Niagara Falls, Ont., has been killed in action, according to official report. Lieut. Anderson was given leave of absence to go to the front with the 98th Battalion in the summer of 1916. He fell on October 28.

Major Kenneth L. Duggan, of the Mounted Rifles, is unofficially reported missing and believed killed. He is the son of Mr. G. H. Duggan, of Montreal, vice-president of the Dominion Bridge Company, and chief engineer of the St. Lawrence Bridge Company. His only brother, Herrick Duggan, of the Royal Engineers, was killed at the battle of Loos, two years ago.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Aylmer, Ont.
Town Council contemplate the construction of 800 feet of 8-inch tile drain. Engineer, W. E. Stewart.

East Oxford Township, Ont.
Tenders will be received by the clerk, F. G. Jackson, Oxford Centre, until November 19 for repair and extension of the Jackson Drain for the Town Council.

London, Ont.
Tenders will be called by the clerk, S. Baker, about December 15 for the supply of asphalt, concrete and crushed stone for pavements costing $250,000 for the City Council.

L'Orignal, Ont.
Town Council contemplate the construction of good roads and bridge. Clerk, E. O. Bertrand.

Windsor, Ont.
City Council contemplate the construction of pavement on Wyandotte Street from Glengarry to easterly limits, costing $75,000. Engineer, W. E. Brian.

York Township, Ont.
Tenders are being received by the engineer, Frank Barber, 40 Jarvis Street, Toronto, until noon, November 26, for trenching and laying of water mains in Lauder Ave. and Glenholme Ave. for the Township Council.

CONTRACTS AWARDED

Contrecoeur, Que.
Gaudette & Lachapelle, St. Ours, have the general contract for the construction of a macadam road costing $10,531 for the Town Council.

London, Ont.
John McMurphy, 224 Queens Ave., has the general contract for tile sewer on Eva Street costing $3,500 for the city Council.

Moncton, N.B.
Gross & Garland, Moncton, have the general contract for the construction of road costing $5,400 from Albert County Bridge to foot of hill for the Board of Works, City Council.

Three Rivers, Que.
The Canadian H. W. Johns-Manville Co., Ltd., 450 St. James St., Montreal, have the roofing and the Phoenix Bridge & Iron Works Ltd., 83 Colborne Street, Montreal, the iron contract for $12,000 pumping station and reservoir for the City Council. The general contractors, Nobert, Dugre & Arsenault, Hochelaga Bank Bldg., Three Rivers, want prices at once on a large quantity of plastic, rustic and pressed brick.

Toronto, Ont.
The Godson Contracting Company have awarded the contract for piping for the High Level Pumping Station to the A. B. Ormsby Company.

Railroads, Bridges and Wharves

British Columbia, Province of
Repairs will be made to bridges across the Similkameen River and Cottonwood River for the Department of Public Works, Victoria, B.C.

Lindsay, Ont.
Excavation work has started for round house, machine shop and coal hoist for the Grand Trunk Railway. Manager, J. D. McMillan, Belleville.

Vancouver, B.C.
The Northern Construction Co., Ltd., 606 Union Bank Bldg., Winnipeg, are receiving tenders on plumbing, heating, sheet metal and electrical work in connection with the erection of train shed, depot, etc., costing $1,000,000, for the Canadian Northern Railway.

CONTRACTS AWARDED

Glenelg, N.B.
D. J. Buckley, Newcastle, has the general contract for Victoria Bridge over Black River for the Department of Public Works, Dominion Government.

Halifax, N.S.
The Nova Scotia Construction Co., Upper Water St., have the general contract for freight shed for the Department of Railways and Canals, Dominion Government.

St. Alexis, Que.
The Dominion Bridge Co., Ltd., 285 Beaver Hall Hill, Montreal, have the steel contract for $14,000 concrete and steel bridge for the Municipal Council.

Public Buildings, Churches and Schools

Athabaska Landing, Alta.
The erection of a hospital is contemplated.

Aylmer, Ont.
Town Council contemplate the erection of market buildings. Engineer, W. E. Stewart.

Chauvin, Alta.
Plans are being prepared for a school for the Public School Board.

New Westminster, B.C.
City Council contemplate remodelling City Hall. Clerk, W. A. Duncan.

Port Credit, Ont.
Plans have been prepared and tenders will be called later for the erection of a $4,000 town hall for the Town Council. Clerk, G. W. Gordon.

St. Catharines, Ont.
Plans and specifications with the architect, A. E. Nicholson, 51 Queen St., who will receive tenders until November 19 for the erection of a $10,000 addition to college for Ridley College.

St. Damase, Que.
Private tenders will likely be received by the general contractors, Labbe & Roberge, Ste. Marie, for interior work for $41,350 church for the Parish Congregation.

St. Louis de Courville, Que.
J. Gosselin, 55 St. George St., Levis, general contractor for church for the Parish is receiving tenders on plumbing, heating and electrical work.

Whitby Township, Ont.
The School Board contemplates the erection of a $4,000 school. Secretary, Fred Gale, R. R. No. 1, Whitby.

CONTRACTS AWARDED

Burlington, Ont.
The Sanitary Floor Co., 145 Brunswick Ave., Toronto, have the contract for composition flooring in connection with alterations to hotel for hospital for the Military Hospital Commission, College Street, Toronto.

Byron, Ont.
The London Utilities Board have the electrical contract for $10,000 vocational school for the Government Hospitals Commission.

Donnacona, Que.
J. D. Lagueux, 180 Fleurie Et., Quebec, has the painting, and F. Gingras, cor. St. Augustin and D'Aiguillon Sts., Quebec, the plumbing, heating and electrical contracts for church for the Parish. The general contractor, L. H. Peters, Ltd., 10 St. Jangele St., Quebec, will carry out the plastering contract.

Fredericton, N.B.
Wm. Minto, 321 Queen St., has the electrical contract for hospital building and alterations to government house costing between $80,000 and $100,000 for the Dominion Government.

Hamilton, Ont.
The following contracts have been awarded in connection with alterations and addition costing $15,000 to hospital for the City Council:—Masonry, Wm. Yates, 24 Leeming St.; painting and glazing, J. Boswell, 140 Wellington St. S.; carpentry, T. J. Drake, 98 Beulah Ave.; plumbing and heating, Adam Clark, 7 Main St. W.; tinsmithing and roofing, J. E. Riddle, Ferguson Ave. N.; iron stairs, Canada Steel Goods Co., Ltd., King William St.; electrical work, Culley & Breay, 35 King St. W.; tiling and marble, Kent Garvin Co., Catherine St. N.

Kentville, N.S.
W. W. Rockwell, Main St., Kentville, has the plumbing and heating, and J. C. Mitchell, Wolfville, the electrical work for $75,000 infirmary and vocational building for the Provincial Government.

Mont Laurier, Que.
Samuel Ouellette has the general contract and is in the market for a quantity of supplies for the erection of a $60,000 cathedral for the Corporation Episcopale du Diocese de Mt. Laurier.

Montreal, Que.
Alexander Craig, 41 Jurors St., has the painting, and the Lepage Marble Works,

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Principal Contents

Irregularities in Day Labor Work in Montreal

THE question of day labor vs. contracts has been again brought to the fore in Montreal by Controller Villeneuve. The city now carries out much of the public work—or at least did so when the money was available—on the day labor plan, with far from satisfactory results. The system is naturally favored by many aldermen for the reason that it affords opportunities for recommending constituents who are anxious to secure these day jobs. Under the Board of Control administration much of the patronage has been abolished, but there is certain to be at best a tendency to get as many as possible on the civic pay roll.

Apart from the patronage evil, the great objection to the day labor scheme is that it is more costly than the contract system—Controller Villeneuve terms it "abnormally costly." "There is," he says, "ample proof that, when such works are completed by corporation work, the cost has exceeded, beyond all reasonable proportion, the price as figured out by the engineers. I might cite an instance where the construction of a sewer figured out no less than $150,000 more than the price originally estimated. Still more glaring cases might be given. No comment is needed to convince one that money ought not to be wasted like this. The Board of Control has before it evidence from its own engineers that 'day work' sewers have actually cost 44 per cent. more than if executed by contract. The unvarnished truth is that, in like manner, our street paving and road building have been carried on with a reckless waste and so contrary to all business principles as to result in enormous loss. Permanent pavements have not only been laid with faulty materials, but have been faulty in their execution."

By competition contractors are perforce compelled to keep their figures at a minimum; there is no such obligation on the part of a city, beyond a desire of the engineers to keep the cost within their estimates. Probably the excessive cost in the case of Montreal can be partly traced to the high rates paid to day laborers, rates which were above those ruling in the open market, and which were no doubt fixed with one eye on the votes of the laboring classes. It is to such causes that one must look for the admitted chaos in the municipal affairs of Montreal.

Motor Accidents at Level Crossings in Ontario

THE Board of Railway Commissioners has issued the following circular: In view of the increasing number of accidents at level crossings in Ontario to persons travelling in motors, the Board desires that a discussion should be had, in which the different motor associations, municipalities and railways interested should take part, and the best possible methods and protection in the interests of public safety be adopted. Without in any way limiting the discussion, the following questions should be considered:

The matter of the view from the highway of any approaching trains. Factors to be considered from the motorist's standpoint are the speed and braking efficiency of the motors, having regard to the fact that the motor must be stopped after the train is seen.

Whether or not there is any difficulty in seeing the standard railway crossing sign from motors, and whether additional post signs on the road would assist in obviating accidents, for example, warning posts placed at some distance in the centre of the highway, about 50 feet from the crossing?

Whether humps or hog-backs should be placed on the road, so as to compel motorists to bring down the speed of their cars to a rate at which they may safely proceed?

Ought motors be brought to a stop before crossing?

Bells or wig-wag signals, which are of the greater benefit to motorists?

Can any change be made in railway regulations which, without injuring the efficiency of the public service, will promote safety?

Ought the regulation whistle signals to be given closer to the highway, or any change be made in the use of the signal or the bell?

Written submissions may be sent by mail to the

Board at Ottawa, and in addition the matter may be spoken of at any meeting of the Board.

In connection with the foregoing circular it may be mentioned that the Vice-Chairman of the Ontario Railway and Municipal Board, A. B. Ingram, suggested recently that the Board's efforts to protect crossings on railways under provincial jurisdiction should be supplemented by the municipalities, which should erect warning boards on the highways, say, 300 feet from each crossing, worded, "Beware. Railway Crossing, 300 Feet," or something similar.

Rural Planning and Development

THE latest report of the Commission of Conservation deals with the important subject of the planning and development of rural districts and small towns in Canada. It has been prepared by Mr. Thomas Adams, Town Planning Adviser of the Commission, who has made a close study of the problem of rural development in this country during the past three years, following twenty-five years experience in farming, land surveying and town planning in other countries.

The report deals comprehensively with the social conditions and tendencies in rural areas and the prevailing systems of land settlement and development. It indicates the rural problems requiring solution in order to secure the proper development and economic use of land for purpose of efficiency, health, convenience, and amenity. The great injury which land development in Canada suffers from speculation, neglect of public health, and want of expert business administration of land settlement, is considered. Incidentally, the problem of returned soldiers is dealt with, and the connection between land development and such questions as taxation, unemployment, and high cost of living is clearly shown.

Having regard to the need for more attention being given to production in Canada; to the extent to which production is impaired by speculation in land, by neglect of public health, and by haphazard systems of development; to the importance of increasing the supply of human skill and energy and of capital derived from production instead of by borrowing; the problems dealt with in this report are of vital and current interest to the people of this country.

There are five appendices by competent authorities, and the concluding chapter gives an outline of proposals and makes general recommendations to cover the conditions as presented.

Standardizing Engineering Symbols

THE table herewith, listing symbols for mechanics and hydraulics, aims to standardize practice in this regard. It has been developed by the Committee on Nomenclature of the Society for the Promotion of Engineering Education as a result of enquiries submitted to professors, editors and engineers. In the light of the suggestions which were received this list of symbols was approved by the committee as an acceptable standard. While it contains omissions, it is believed to hold the nucleus of a standard list of symbols for this country because it is composed of symbols that are in general use. It is presented in the hope that it will assist in the evolution of a standard list. It is short. It contains no Greek letters. It is mnemonic to a considerable degree and deals largely with mechanics because that branch is common to all the divisions of engineering.

SYMBOLS APPROVED BY THE COMMITTEE

Concept	Symbol	Concept	Symbol
Acceleration due to gravity..	g	Inertia, Polar moment of ..	J
Acceleration, linear	a	Inertia, Rectangular moment of	I
Area	A	Length	L
Breadth	b	Load, Eccentricity of application of	e
Center of rotation	O	Mass	m
Coefficient of friction	f	Modulus of section	Z
Coefficients and constants..	C, K	Modulus of Elasticity, Young's	E
Deflection of beam	Y	Quantity of liquid flowing..	Q
Depth	d	Radius	r
Diameter	D	Radius of gyration	k
Distance passed over	s	Reactions	R
Distance of extreme fiber from neutral axis	c	Revolutions per unit of time	N
Efficiency (Hydrau., Mech., Vol.)	eh, em, ev	Stress, unit	S
Force	F	Time	t
Force, Moment of	M	Torque	T
Head	H	Velocity, angular	w
Height	h	Velocity, linear	v
Horsepower	Hp	Volume	V
Hydraulic radius	Rh	Weight	W

C.S.C.E. Remembers its Soldier Members

THE Canadian Society of Civil Engineers is sending parcels of tobacco to the 800 members who have enlisted. The fund has been very liberally responded to from all parts of the Dominion. A letter of greeting with a card for acknowledgement will be enclosed with each parcel. The letter reads:

To the Men on our Honor Roll:

The Council and Members of the Canadian Society of Civil Engineers desire to express to you their heartiest greetings and best wishes for your good health and well-being.

Your fellow members at home have a very definite appreciation of the good work you are doing, both for the profession and for the Empire. You have sacrificed much, risked much and done much to make us all proud of you. Your name has been inscribed on the Honor Roll, to hand for all time on the wall at the headquarters of the Society, as evidence of the fact that you have done your share in fighting for the Empire and for civilization.

It gives me much pleasure to convey this message to you, as well as the parcel herewith, which expresses in a very slight degree our high regard and the esteem in which you are held.

On behalf of the Society,

Fraser S. Keith, Secretary.

Advises Building Now

"Now is the time to build," says Mr. J. P. Anglin, president of the Montreal Builders' Exchange, in discussing the disinclination of some to build in the hope of lower prices for building material. This advice is based on a belief that prices of material will advance and more difficulty will be found in securing material. At the last meeting of the directors of the Exchange, Mr. Anglin suggested that some of the restrictions and inconsistent and vexatious building by-laws of the various municipalities on the Island of Montreal should be suspended. Mr. Anglin pointed out that these laws, together with the chaotic condition of the Montreal building regulations, the irregular prices of materials and labor, militated against the chances of a man of moderate means owning his own home. Under present abnormal conditions vexatious by-laws should be suspended, and if the common sanitary arrangements were enforced, the proprietor should be allowed to consult his own convenience with regard to the size and arrangements of rooms and materials.

Awakening Recognition of the Engineer

The Canadian Society of Civil Engineers is Undergoing a Forward Movement Leading to the Elevation of the Profession to the Status Demanded by Its Achievements—Address to Ottawa Branch C.S.C.E.

By Fraser S. Keith*

ANY discussion regarding the awakening recognition of the engineering profession must consider to what extent the awakening has occurred and what must be done to make the recognition complete.

The awakening has already taken place in the profession itself, and the extent to which recognition may grow on the part of those outside the profession depends entirely on how far that awakening has occurred within ourselves, and to what extent we are prepared to arouse those outside to a similar sense of awakening.

The recognition from within is a forerunner of the recognition from without, and must be by it inspired.

Let us glory in the fact that we have become alive to a sense of our position and our possibilities, but let us not deceive ourselves as to the headway that has been made. We have awakened, it is true, but are very much in the position of one aroused from a long sleep. We are yet blinking and rubbing our eyes and wondering just what we should do, because the full light of what might be and what should be has come to us, and finds us lacking somewhat in initative. During the past decades the engineering profession has been the fountain source of material advancement and has been a mighty modernizing and civilizing force down to the present minute, yet as far as real recognition of the achievements of the profession and its elevation to its real status in society is concerned, we have advanced little beyond the glacial age of tradition; so that fierce fires of enthusiasm will be needed to melt the ice-bound barriers of precedent with which we have to contend.

You all know that for some years past there has been a general feeling of unrest on the part of engineers in Canada, the United States and Great Britain. This has given rise to a general searching and questioning as to why the engineer is not occupying the position to which his ability, education and accomplishments justly entitle him.

Unrest in Society

In our own Society this unrest, which has been, in truth, a feeling of dissatisfaction based on a certain anxiety towards improved conditions has resulted in the appointment of a Committee on Society Affairs. But, after all, is not this the result of professional consciousness which has arisen and demands expression in activity?

At the last meeting of Council, held on October 30th, the report of the Committee on Society Affairs was accepted and approved. The report as approved by the Council is now in the hands of the printers and will be issued to our corporate members of the Society within the next few weeks. A vote is to be taken, returnable in time for the annual meeting to determine if these recommendations meet with the full approval of the membership at large. Not even the members of the Committee believe that the proposed by-laws are at present perfect, but if adopted, will mean a long step in advance, and will pave the way for any further improvements that may be proposed.

The extent to which the individual member realizes the suggested changes, and personally sets about to carry into effect the program as contained in the report of this Committee, will determine how much the Society and the profession have awakened to a realization of a proper perspective of what is required by the profession in its relations with the outside world.

What the Awakening Means

The distinctive feature of this report is the increased sense of responsibility of our Society, which means the profession, in its relation to the individual member, and of greater importance still, in its relation to its service to the public at large. We have, therefore, apparently reached a point where we know that our former objects were limited and our activities circumscribed, and it is now possible, with that knowledge, to go further, believing that the future of the profession lies largely in how far it is willing to assist the individual member and to what extent he may co-operate with the profession in dealing with all public matters, whereby our interests are affected, using this newly awakened sense in making our combined influence felt outside of the Society. It would then appear that (and let me emphasize) **the awakening of the engineering profession involves, in the first instance the increased recognition of the profession's responsibility to the individual, and the individual's responsibility to the profession, and in the second place their collective responsibility to the public, and in turn an acknowledgement from the public of the engineer's real place in national affairs,** which includes status, remuneration and opportunity of service.

Recognition from Without

You will find, generally speaking, that the recognition engineers have received has been as individuals rather than as a profession. Fifty years ago the engineer was a skilled laborer, and his status was such. During that time he has become a man, highly educated, highly trained, and so successful in his application of knowledge to material things, that his work has wrought untold benefit to humanity. The great achievement of the engineer in revolutionizing the material welfare of mankind has fitted him to shoulder greater burdens and responsibilities.

The gradual evolution of the status of the engineer has forced him to take account of other laws and forces than those of mathematics and science, so that today he is compelled (almost without realizing it) to consider economic and social problems, and particularly those arising out of a proper appraisal of equity between man and man. The latter includes a study of the complex problems of tax valuations as between individuals and corporations, advice as to financing of public works, and advice in arriving at just and equitable rates for service rendered by public utilities. The engineer is thus becoming not only one who directs the great sources of power in nature for the use and

* General Secretary, Canadian Society of Civil Engineers.

convenience of man in the most economical manner possible, but he is fast becoming an economist and an arbiter in industrial problems.

When a Committee was appointed in 1915 by the President of the United States from the National Engineering Societies to constitute a Naval Consulting Board and Committee of Industrial Preparedness, the profession received its highest recognition. This, in fact, is an epoch in the relation of engineers to national affairs. Of this action on the part of the President, Thos. A. Edison said, "This marks almost dramatically the entrance of the trained non-partisan, doing his work on the sole basis of efficiency and integrity, into the affairs of the Government." The men who are thus chosen have an opportunity of not only making a name for themselves, but of adding much to the prestige of the profession, and there is no doubt whatever that they will do so.

Why Engineers Should Have Recognition

It cannot be said, however, we have made any considerable headway towards being recognized in Canada. In his message to the people of Canada on the 50th Anniversary of Confederation, Sir Robert Borden reviewed the development of production, commerce and wealth; the immense increase in transportation facilities; the conspicuous rise in the standards of living, and the great improvement in the general conditions of life throughout the Dominion. He pointed with pride to all this, yet he failed to remark that each and every one of these indications of advancement owes its present state directly to engineering skill, and to engineering progress. In the past, we have not, as a Society, recognized, and consequently are not in a position to enthuse others with the fact, that all material advancement in the history of the world's existence has had its foundation on engineering in some one or other of its branches. It is therefore not to be wondered at that members of governments, politicians and the man on the street are ignorant of this fact and fail to give credit where credit is due.

Engineer Fuel Controller

It is only recently that the government of this country has come to the point of recognizing, even in the most limited sense that the training of the engineer eminently fits him for any special position of executive responsibility. When the Premier appointed Mr. C. A. Magrath, M.Can.Soc.C.E., to the chairmanship of the International Joint Commission he felt called upon to apologize for appointing an engineer, because it has been generally understood that positions of this kind were the special domain of the lawyer. As you know, Mr. Magrath since his appointment, has more than justified it in every sense of the term, and later, as Fuel Controller, has handled the fuel situation of Canada, although his problem was a most difficult one, in a manner that commands the admiration and respect of all.

Engineer Food Controller

The Government of the United States appointed as Food Controller Herbert Hoover, M.Am.Soc.C.E. Canada appointed a lawyer for this office. Note the difference. The engineer went about his work with the idea foremost in his mind of carrying out and securing the desired result for which a Food Controller was needed, namely, to conserve food resources, assure reasonable prices, eliminate profiteering and assist the Allies to secure supplies. The work of the engineer Food Controller in the United States has resulted in the prices of food products steadily decreasing, while in Canada during the same period, they have increased by leaps and bounds.

Here we have a practical, definite illustration of the difference of what is to be expected from the appointment of an engineer when something definite was to be done, in contrast to a lawyer. This is possibly the first time we have had an opportunity of comparing the methods of the two, and we owe it to ourselves to educate the public to this fundamental difference of attitude of mind and directness of purpose between the methods of the engineer and the politician. The significance of this example cannot be too strongly emphasized and cannot be too firmly impressed upon the minds of the citizens of this country.

Engineer Recruiting Officer

Our own president, Col. John S. Dennis, was appointed by the British Governemnt, some months ago to take charge of the British recruiting mission at Chicago, and the record he has established as recruiting officer stands without a parallel for achievement on this continent. During the time he has been actively engaged over twelve thousand volunteers have been recruited, more than were enlisted in the whole of Canada during that time. After one speech he made in Providence, R.I., 76 men applied for admission to the Canadian Army. Last month Col. Dennis, who is sixty years old, in the course of his work, travelled by rail nearly five thousand miles, marched three hundred miles on foot, visited thirty-two places and made sixty-seven speeches. This illustrates again the inbred sense of responsibility and joy in accomplishment, without practical thought of reward, that characterizes the engineer.

Part Played by Engineers in the War

If the striking manner in which engineers carry out special work assigned to them is not sufficient to give the whole profession added prestige, then the part played by our gallant men in connection with the great war should surely have some effect. We have nearly thirty per cent. of our entire membership actively participating in the war. They have performed deeds of bravery and endurance that would put to shame the heroes of history or mythology. They have made it possible to conduct the great campaigns by providing transportation, water and sanitary facilities, while exposed, for the most part, to the fire of the enemy, and the war will be won largely by the superior engineering skill of the Allies in comparison with the Germans, whose whole history has been one of stolen ideas.

It would be well perhaps if we considered the engineering profession in the light of conquerors; the title Conquerors was given to a special publication of the Cleveland Engineering Society, which described notable engineering achievements. The more one dwells upon the thought the more fitting becomes the simile of applying the term conquerors to the profession, for the engineers have been conquerors in the highest and best and noblest sense of the word, as it is the engineer who has succeeded in overcoming the turbulence of nature, eliminating distance, conquering space, and making the earth, the sea, and the air subservient to the welfare of mankind.

Unity and Co-operation

To accomplish any near approach to our possibilities greater unity and co-operation will be necessary. These to some extent might become our watchwords.

Events in the world of engineering activities show clearly and unmistakably that a new era is dawning for the profession. The insularity of the engineer is slowly but surely giving way to a fraternity of spirit that has been almost entirely lacking in the past. The former idea of specializing in various groups has been transformed to a broader vision with a tendency towards union of all branches of the profession.

Engineering Council

You have seen recently for the first time in the history of the profession a national engineering board appointed by the United States from the parent engineering societies, whose whole tendency seems to be towards closer union and greater co-operation. To some extent we are in a more advantageous position in Canada, as we have now made it possible to unite all the engineering professions in one great national body instead of starting a number of organizations as was done in the United States. It will mean that the members of our organizations will have to work as a unit and co-operate in the closest possible manner. The situation affords a great opportunity to the engineering profession, an opportunity in which every individual may take an active part, a chance to advance the interests of the profession in one great body of such strength of sufficiently high standard and at the same time broad enough to make it the goal of every man in this country who aims or claims to be a member of this high calling.

Developing a Heart

We have been criticized in the past, not only because we were accused of being narrow in our objects, but also it was stated we were collectively without a soul or heart. Be that as it may, if the heart of the profession were a composite heart of the individuals therein it would leave nothing to be desired, but we must admit there has been some coldness and to some extent indifference, and we should therefore to the greatest possible extent cultivate a fraternal spirit that will develop a heart in our organization, a pulsating, personal heart throbbing with human emotions, and cause that heart to beat warmly and sympathetically not only for our own members, but in our relations with the outside world.

It is in developing this spirit that the branches will play a great and ever increasing part. While we have a headquarters and a council to give general directions to affairs, the branches are the active energizing agents of the profession, and it is to them that we must look for the greatest personal activities. You know, gentlemen, of the opportunities that may arise whereby a branch may take an active part in local affairs for the benefit of the whole profession. We have an instance of this in the part played by the Calgary Branch, when they stood behind the City Engineer, who was being severely criticized in the building of the Centre Street Bridge, and were enabled to prove to the public that his critics were unjust. From this affair both the City Engineer and the Branch emerged with added respect and prestige.

Opportunities for Service

It is possible for a Branch to include in its discussions public matters of local interest, even where the Branch is not directly concerned. In fact, as a profession we will make greater strides if we give fuller discussion to public questions and less to technical subjects than we have in the past. The Branch should be more than a mere unit of the local members of the profession. It should be a fraternal organization meeting in a spirit of good-fellowship. It should encourage the younger members in every way and give them an opportunity of learning public speaking, as well as absorbing the ideas of the older men in the profession. It should be ever and always on the lookout for opportunities for service. The Branch should be the technical centre in any community and could possibly take an active part in the technical education of the district or at least give advice thereon.

The big opportunity for service is coming in connection with the vocational training for returned soldiers; and in this the branches could play a leading part. No more worthy object can be thought of than this, and there is no other body of men similarly capable of giving assistance in this respect. In the United States the local engineering bodies study political questions to keep an active tab on the doings of local legislatures where the welfare of the profession is concerned; they act as Advisory Boards to Municipal Councils; they suggest legislation and in numerous other ways make their voices heard and influence felt. It is, therefore, to the branches that we must look for the full flower of development of the profession.

Outcome of Proposed Changes

The proposed changes in the by-laws, as well as the change in name, will to some extent increase the prestige and standing of our various branches. Each branch will elect its own councillors and will consequently be more directly represented at the headquarters of the Society than at present. It is intended to hold an annual meeting of the Society once a year in every province. This meeting will be directed by Council, will have representatives present from headquarters, and the official report of the meeting will be published in the annual report. These changes are based on the admitted necessity of greater fraternity and closer co-operation, and will enable the individual member to come to a better appreciation of his fellow members, together with a personal responsibility to the Society and to the profession. The object of our organization in the future will be of a broad enough nature to enable the Society both at headquarters and from its branches to engage in useful public service.

Earning Capacity and Reward

Some of you have asked yourselves the question, where does all this lead to and how does it affect our earning capacity? Two definite factors in increased earning capacity are—additional usefulness and added recognition. The usefulness must come from within, and we may take it as an established fact that the engineer has already proven his usefulness over and beyond his monetary reward. Recognition will come from corporate usefulness and educating the public to a better appreciation of what the engineer is really doing. One of the technical journals in discussing the question as to when engineers will be better paid, says, "The inevitable conclusion of any careful study of this question is that engineers will continue to draw low salaries as long as they will work for them. Meanwhile discussion of the question is not wholly without value as men can talk themselves up to the point of making even a bayonet charge. Perhaps after some more years of discussion engineers will begin to ask themselves: 'What are we going to do about it?' After some more discussion somebody will suggest that engineers must demand better pay. Again, after still further discussion, the suggestion will be adopted. Then, and not until then, will the engineer become a permanently well-paid professional man."

Men in Government Service

Let me ask you, what position would the Government of Canada be in today in carrying out the nation's work without the services of the men in the engineering profession? The majority of the departments of the government would be unable to operate without our help. Do the political members of the Government realize that this is true? It is certain that they do not. Why? Because we of the engineering profession have in the past taken no corporate action to insure that they should. Instead we have to some extent acted like dumb driven creatures, accepting the crumbs that have fallen by the wayside, content to sell superior qualities of mind and training for a mess of pottage; for despite your capacity, such in general is your reward in comparison with your true worth. As individuals it may not be possible to force the recognition needed, but as a body we are a mighty power capable of securing any reward within reason upon which we set our minds and hearts. It is not only in the government service that engineers receive inadequate reward, but throughout the entire profession, and particularly those employed at railway work.

Men in Railroads

There is one active full member of our Society who is a resident engineer on one of the transcontinental railways, and his salary is $100 a month. He has a wife and family. Whose fault is it that such is true? Yours and mine. How much longer is the engineering profession going to continue to be underpaid? Just as long as we permit it, and no longer. We have it in our hands to bring about a different state of affairs, but action is required, not words. We have talked in the past a great deal about inadequate rewards, and we may continue to talk, but nothing will be accomplished until we secure a higher standard of reward, and we shall find the accomplishment so easy that the wonder will be why we had not thought of doing so sooner. We are today exactly in the position of the man staying out all night on his own doorstep because he thought he could not get in, only to find out in the morning that he had the key in his pocket.

Education Necessary

The government and railway officials and the general public have only a vague conception of what they owe to the engineering profession for their material welfare, and they will continue in ignorance until we have educated them. In the meantime it is we who are culpable, not they.

The newspapers in this country are the great moulders of public opinion, and it is to them we must look, to some extent at least, for co-operation and assistance. For once we have convinced the editors that in doing this they are assisting in the public weal, the natural patriotism that characterizes the editorial body would prompt them to act and give their hearty support.

The Future of the Profession

To those of you who have become discouraged over the outlook of the engineering profession, let me carry a note of optimism, for the star of the engineering profession has risen above the horizon, it is well started on its upward path of glory and eminence, and just as surely as the past century was an era of material development unprecedented in history, credit for which is largely due to the engineering profession, just so surely will the coming century see a similar social improvement, whereby the social conditions of the great mass of mankind will be improved, and to a similar extent as were material conditions during the past century, and the group of men who wrought the former change will also be responsible for the greater change that is to come.

The lawyer and the politician have admittedly failed to solve the industrial relations of man to man and the relations between capital and labor. The very qualifications of mind and training that have enabled the engineer to so successfully grasp and solve any problem set before him will be called upon and required to solve and to deal with what will be, after the war, the greatest problem which we have to face.

Engineer in Industry

We find already many of the executives of large industrial concerns being chosen from our own profession and more and more will the men who have received a thorough training in technical matters be called to the high positions in industrial affairs. This will mean the opening up of a scope for the profession, giving rise to a future that will place the technical man in control of the industrial life of the nation. Coincident with that is arriving a condition whereby the engineer must, besides drawing plans and specifications, give his advice in connection with financing of any industrial or engineering undertaking, so that the time is coming, and very soon, that the engineer instead of receiving the reward that capital is willing to offer, will walk hand in hand with the capitalist, on an equal footing, and will share in the rewards that the other has heretofore enjoyed.

In view of such enticing prospects and possibilities for the individual, what limit is there to our development as a profession by acting in unison? Here we are, a powerful legion with all the potential attributes of mind, heart and soul to carry us to undreamed of heights of eminence, and how far we shall rise as a profession is only limited by the minimum amount of effort which each and every one of us is prepared to give in conjunction with his fellows to make what is reasonably possible a living reality.

And speaking from knowledge, gained by experience in my relations with you, gentlemen of the Ottawa Branch, you who have been leaders in the affairs of the Society in the past, I know full well that in the forward movement leading to the exaltation of the profession, you are certain to play a very important and a very prominent part.

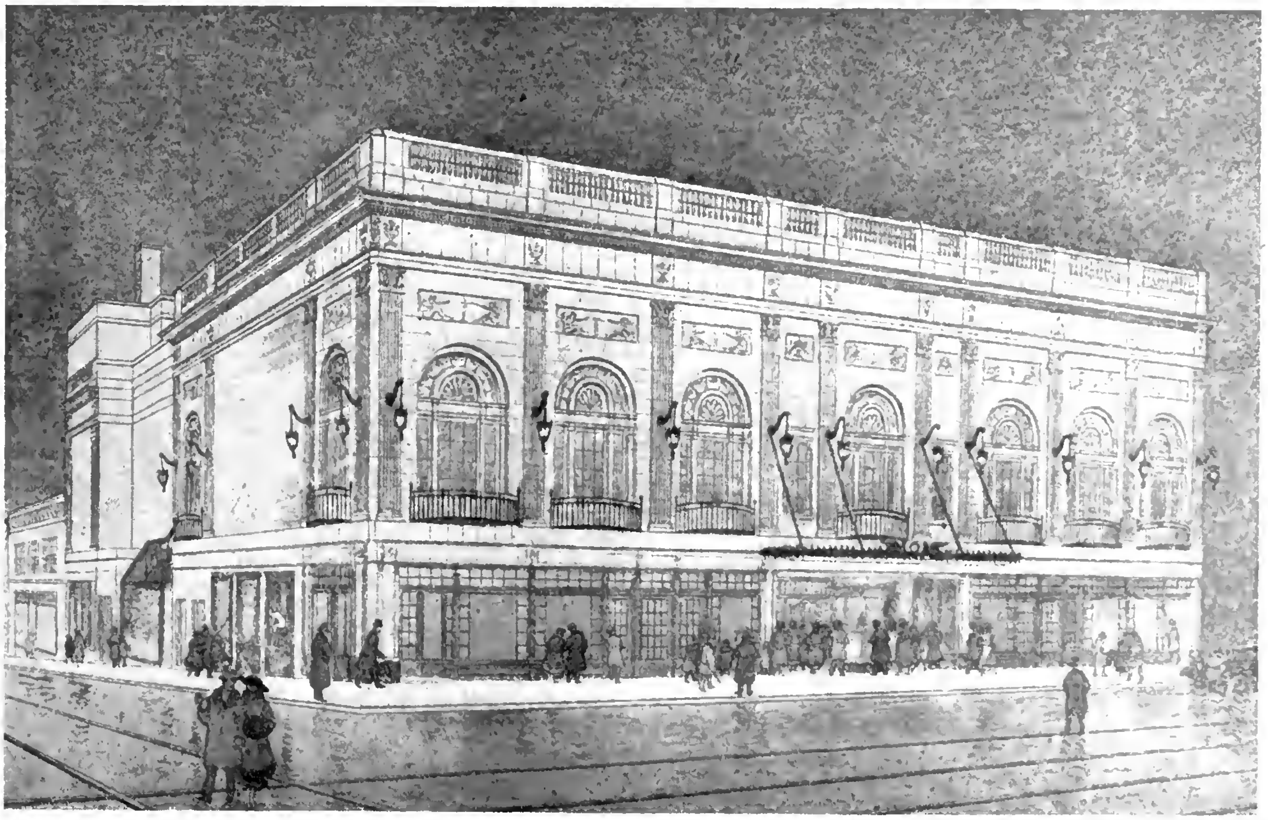
Mueller Manufacturing Company's New Plant

The plant of the Mueller Manufacturing Company, Limited, at Port Huron, Mich., is fast assuming definite shape. The foundations for the foundry and extrusion buildings are under way, and steel erection will commence immediately. Plans are now being prepared for the power house, a building 60 ft. x 100 ft. The Sarnia Bridge Company are doing the steel work; the Sullivan Construction Company the general contracting, and James, Loudon & Hertzberg, Limited, of Toronto, are the consulting engineers.

Toronto Has Theatre of Unusual Design

Amphitheatre Style of Auditorium in Allen Theatre is a New Departure—A Concrete, Hollow Tile and Steel Building

On Saturday, Nov. 10, the new Allen Theatre, at the corner of Richmond and Victoria Streets, Toronto, was opened to the public. This building is the latest and one of the finest of Toronto's motion picture houses. In design it is a departure from anything that has been attempted in this country heretofore, the arrangement being of such a nature as to be specially adapted for the exhibition of screen plays. The main feature is the amphitheatre, or Roman style of auditorium, which, being without balconies or columns of any kind, provides an unobstructed view of the stage and a seating plan whereby no location is at a disadvantage. The seating capacity is about 1,600. While intended primarily as a picture theatre, with minor alterations it may be converted into a legitimate playhouse at any time.



Exterior appearance of theatre from architect's perspective.

The new structure, measuring approximately 111 ft. by 124 ft. over all, is situated on the southwest corner of Richmond and Victoria Streets, with the main entrance off Richmond Street. The auditorium is approached from the Richmond Street front through a vestibule containing the ticket booth, the entrance being covered with a cast-iron marquise. From the vestibule a lobby about 27 x 17 feet leads to the foyer. Four pairs of swinging doors are provided at the lobby entrance and exit. The foyer runs transversely across the house on an arc of about 81 ft. radius. Off it are a large rest room, women's retiring room, men's smoking room, check room, manager's office, and lavatories.

The main auditorium is built on the amphitheatre style, without balconies. The seats are arranged in circular tiers of one foot rise per tier. The total rise from stage to top row of seats is about 28 ft. There are thus no balconies or obstructions to a clear view of the stage from any part of the auditorium. The seats are sufficiently banked to put no patron of the house at a disadvantage in regard to his ability to view the stage.

The auditorium is approached from the foyer by four ramps. The pit, or lower part of the theatre, is reached by two practically level ramps leading to a transverse cross aisle, from which access is had to the lower bank of seats. To reach the upper portion of the auditorium two inclined ramps, one on each side of the foyer entrance, lead to an upper cross aisle about 10 ft. above the lower aisle. The rise of these two ramps has been so arranged that one walks up them without effort. From the upper cross aisle are reached the seats in the upper part of the auditorium.

The stage, or orchestra platform, is crescent-shaped, and has an organ space on each side, with a passage-way behind the screen. Dressing-room accommodation is provided. There are also side wall boxes, access to which may be had from either the lower or upper cross aisles.

One feature of the design is the large number of exits, in excess of the legal requirements. Besides the regular exits by means of the ramps, emergency exits are established at each end of the foyer and at each end of both the upper and lower cross aisles. These open on Victoria Street and the side lane, and are protected with kalamein doors. The street level is reached from the upper aisle exits by fire escapes roofed with corrugated iron. The fire escapes are inset in wells so that they do not protrude beyond the street lines. Exits from the top of the auditorium lead directly to the street, and have no connection with any other part of the house.

In addition to the theatre proper, store and office accommodation is provided. The excess street frontage is devoted to small stores, there being six on Richmond Street and one on Victoria Street. Above the stores is an office suite, independent entirely of the theatre, and reached by stairways from the street. The auditorium floor at the Richmond Street side rises sufficiently high to permit of the accommodation of these offices below it and above the stores.

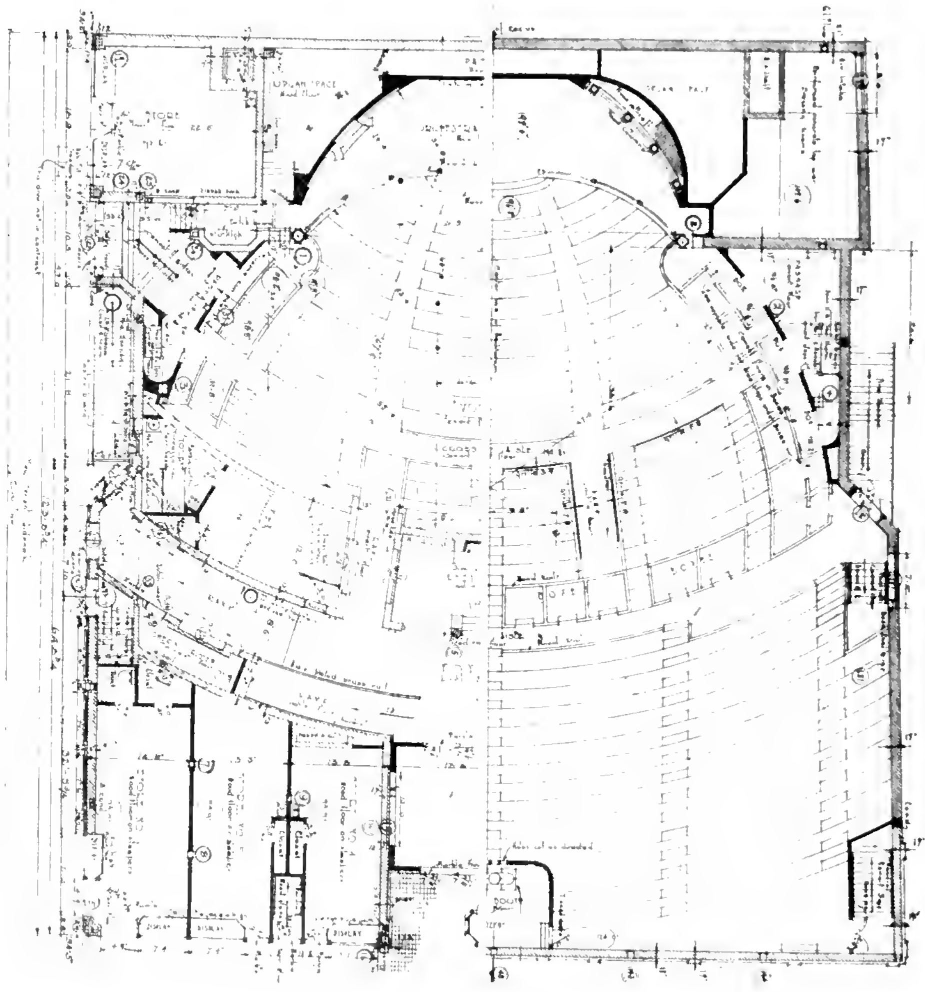
In general construction the building is of reinforced concrete, with brick and and tile walls and steel roof trusses. The foundation walls up to grade are of concrete, on spread continuous footings. A basement is provided under the south or stage portion of the theatre only. This accommodates the heating and ventilating apparatus, etc. The remaining portion of the theatre below grade is unexcavated except for plenum chambers.

The exterior walls are carried up in Denison interlocking hollow tile, faced with rug brick and artificial stone trimmings. The auditorium floor is concrete, carried on tile supporting walls and reinforced concrete columns. It is in reality a beam and slab design, with main girders spanning columns transversely and inclined beams longitudinally carrying the stepped floor. Each riser of the floor is considered a beam and each tread a slab.

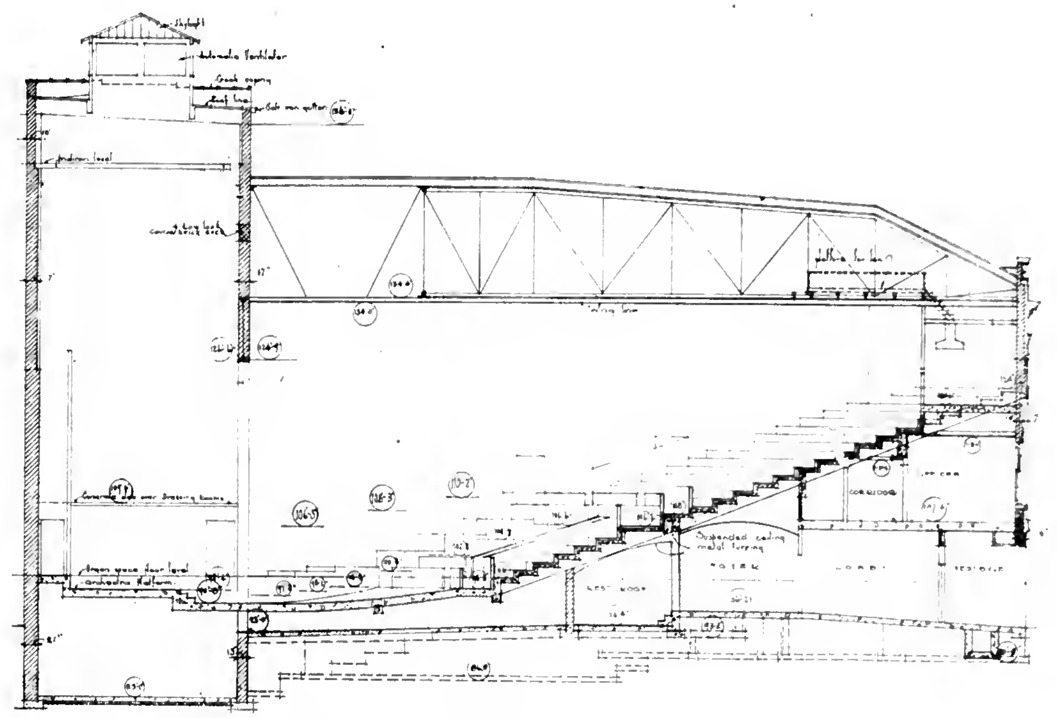
The roof is carried on steel roof trusses, there being a main truss about 106 ft. in span from the Victoria Street side to the lane, with three abutting trusses to the Richmond Street side. The main truss is carried on steel columns, placed a few feet from the walls, the ends of the truss cantilevering over to a bearing on the wall.

All interior bearing walls are of hollow tile, while alabastine blocks form the partitions and furring. A few partition walls are made of metal lath and plaster on studs.

The decorations throughout the entire building have been carried out in the Adams style. The walls and ceiling of the auditorium, foyer, and lobby are decorated in ornamental plaster. The ceiling of the auditorium suspended from the roof trusses is a special feature. It is designed in a fan shape, with coved ribs



Left half of drawing shows first floor plan; right half shows plan of auditorium



Section of Allen Theatre, showing design of auditorium.

radiating from the centre. The panels between the ribs are filled with relief plaster ornament. Around the outside of the ceiling circle, the perforated ventilation grilles are placed. The lighting arrangements comprise drop fixtures and recessed lights with diffusing shades. The stage has a dimmer system.

The exterior of the building is trimmed with artificial stone pilasters and caps, sills, lintels, and cornice with rug brick panels. The base is marble. The parapet is of rug brick, with stone coping.

The theatre was designed by C. Howard Crane, Detroit, who was associated with Hynes, Feldman & Watson, architects, Toronto. The Frank Farrington Company, of Detroit, were the general contractors. The following were sub-contractors: Stone, Peerless Art Stone Company; steel, Dominion Bridge Company; plumbing, heating and ventilating, W. J. McGuire, Ltd.; ornamental plaster, W. J. Hynes, Ltd.; roofing, H. W. Johns-Manville Company; ornamental iron, Canadian Ornamental Iron Company; sheet metal, Douglas Brothers; seating, American Seating Company; draperies and carpets, Robert Simpson Company; marble, Canada Glass, Mantles and Tiles, Ltd. The heating and ventilation equipment was furnished by the Waldon Company, Ltd. Denison hollow interlocking tile was supplied by the Sun Brick Company; face brick by the Milton Brick Company; glass, Toronto Plate Glass Company; mill work, T. H. Hancock; hardware, Aikenhead Hardware Company; organ, Hillgreen-Lane Company.

The published proceedings of the fourteenth annual convention of the American Road Builders' Association are now available. The meeting was held at Boston, Mass., in February. The volume contains the papers and discussions presented at the convention, together with the reports of the secretary and treasurer, list of members, etc.

Approving Montreal Building Permits

Mr. A. Chausse, architect of the city of Montreal, has taken issue with Mr. Tremblay, head of the fire department, on the subject of approving building permits for theatres and other buildings to which the public is admitted. Chief Tremblay desires to be consulted before the permits are issued; Mr. Chausse objects to this on the ground that it is unnecessary, as in addition to being approved by the city architect such plans must be passed by the provincial inspector. In the larger American cities, adds Mr. Chausse, the fire department has nothing to say regarding building permits.

Tenders Soon Called for Sarnia Incinerator

Plans and specifications for the incinerator at Sarnia, Ont., are now complete, and as soon as some technicalities in regard to the site have been cleared away tenders will be called. The tenders will call for work to commence by April 15th, 1918, and contracts will be let in three contracts, i.e., radial brick chimney, building and furnaces. The estimated cost is $20,000. James, Loudon & Hertzberg, Ltd., of 36 Toronto Street, Toronto, are the engineers, and plans and specifications may be seen at their offices.

"County Road Legislation"

"County Road Legislation," is the title of a compilation recently prepared by the Ontario Department of Public Highways. It is an appendix to the annual report, comprising the Highway Improvement Act and provisions of the Ontario Highways Act relating to county roads. It has been prepared to meet the needs of county authorities, a number of whom have just recently adopted systems of county roads.

Shipyard for Wood Vessels

Fraser, Brace & Co.'s Plant Located Near Labor Market—Details of Layout

MESSRS. Fraser, Brace & Company, Limited, of Montreal, became interested in the construction of ships last winter when the question was generally discussed in the newspapers. At first it appeared as if the large size of the timber required would preclude the building of wooden ships at Montreal, particularly as the demand was for much larger ships than had been built of wood in past times when wooden ships were the rule. Further consideration indicated that the finding of timber was not the only feature, and that an adequate labor supply might prove to be more vital. Careful investigation was made of the facilities for obtaining timber in the neighborhood of Montreal, and this company became convinced that the best course would be not to attempt to build a yard in British Columbia, but to arrange for the transportation of the timber and do the construction work close to the best labor market.

The final question of a selection of a site resolved itself into a comparison of the advantages of tidewater in the neighborhood of Quebec city as compared with the advantages of a constant level of water on or above the Lachine Canal. Finally, it was considered that the large number of ships required could not be built with the amount of labor available near the city of Quebec and that if a wide market had to be searched to obtain the necessary labor it would be easier to operate in Montreal. The most serious feature in Montreal was found to be the high price of the land suitable for the purpose.

Location of Ship Yard

After a comparison of a number of sites and consultation with the different parties interested, a location on the south bank of the canal, west of Atwater Avenue, but east of the Cote St. Paul bridge, was selected. The land belonged to the Cote St. Paul Land Company, being part of the Frothingham Estate. This land included an old basin about 350 feet in depth covered with water to a depth of about eight feet. The opening into the Lachine Canal is about 45 feet wide and is covered by a rolling lift bridge which carries the C. P. R. tracks and the toe path across the entrance of the basin. On the south side of the property the Cote St. Paul branch of the railroad runs, and immediately south of that the Montreal aqueduct.

About eight acres of this land has been secured by Fraser, Brace & Company, and it is now improved and ready for the construction of ships. The first act was to unwater the basin by closing off the opening into the canal, a power excavator was then put to work and the basin deepened and straightened, the spoil being deposited on the westerly side of the basin to make good land where shallow water had been previously. The following buildings were erected: Office building, storehouse, blacksmith and machine shop, sawmill, molding loft and framing shed. The sawmill is 50 ft. wide and 200 ft. long, and the framing shed is 50 ft. wide and 100 ft. long, being the principal building on the site.

Launching Arrangements

The company has a contract with the Imperial Munitions Board for the construction of four 2,500 ton deadweight wooden steamers. The contract is for the hulls only, the machinery and boilers to be installed by other parties. Two of the hulls will be built in the bottom of the basin and when complete will be floated by emptying water into the basin. The other two will be built alongside of the basin and will be side-launched into the basin after the launching of the first two. The basin is large enough to permit of the construction of two more boats and additional boats can be built in the site opposite to those now under construction. The bottom of the basin is limestone, offering an excellent support for the keel blocks, but piles have to be driven to support the keels and launching ways of the steamers on shore.

Air Machinery Reduces Cost

The contractors have provided an unusually large compressor for the supply of the various new pneumatic machines which have come on the market as labor savers in the construction of wooden ships. An effort will be made to reduce the cost of handling the very heavy timbers by means of air lifts and travelling cranes.

While the major portion of the material has been purchased in British Columbia the company has arranged for a considerable supply to be cut in the neighborhood of Montreal and to be shipped in in the form of logs and cut on the site. It is expected that some of the very large knees required in the construction of the ships can be procured in the yellow birch or maple in this vicinity. Local rock elm is also suited for the outside planking of the ship and a certain amount of spruce can also be used.

The contractor has detailed plans showing the various crooks and other timbers required in this work, and these are now in the hands of the owners of local limits and contracts have already been let for considerable quantities to be cut and hauled out this winter.

Fraser, Brace & Company is a general contracting company, and has not previously engaged in the construction of any boats larger than ordinary river scows and tugs. Their principal experience has been in the construction of large hydro-electric developments, such as the Cedars Rapids plant, and difficult foundation work of all kinds. The company has turned its attention to the building of ships with the idea that, after all the shipyards already in existence have turned out all the ships they can possibly build, there will still be a shortage of ships, and, to make good this deficiency, additional facilities must be procured and organization provided to produce boats enough to overcome the efforts of the submarine.

Montreal Shoe Concern Plans Slow-Burning Factory

MR. J. E. Huot, architect of Montreal, has drawn plans for a shoe factory for Mr. J. I. Chouinard, of the Star and Regina Shoe Companies, Montreal. The factory is being erected on Aird Avenue and Girard Street, Maisonneuve, and will consist of a building of three storeys, basement and sub-basement, and an annex. The site for the main building is 50 x 150 feet, and for the annex, 52 x 15 ft.

The factory is to be of the slow burning type, mill construction. The foundations are of concrete and the exterior plastic brick. The sills and lintels will be of concrete with the sashes of wood and double glass.

The structure is supported by concrete piers in the basement, resting on 4 x 4 double footings, with wooden posts on each storey. The floors are to be of wood, 5 x 2 inches.

Two entrances will be provided, the main one, on Aird Avenue, being of stone, while the other will be for employees, on Girard Street.

The space on the floors will be laid out for the manufacture of shoes, with the exception of a portion of the first floor, where the general offices and manager's room will be located. The boilers and coal room will be in the sub-basement. The annex will contain lavatories and elevator, and on the second and third floors separate recreation rooms for men and women, with coat rooms. The annex communicates with the main factory. Structural iron fire escapes will be provided on each floor, while the entire building will be equipped with sprinklers. Heating will be by steam, the Webster system being adopted.

The contract for the concrete and brick work, carpentry, painting and glazing has been let to Mr. A. Gratton, Maisonneuve; the heating to T. Lessard & Son, Montreal; and the roofing and plumbing to Mr. J. St. Amand, Montreal.

No Justification for Minimum Road Width

66 ft. Standard an Economic Absurdity—Conditions Must Determine the Width—From Report of Commission of Conservation

By Thomas Adams*

MOST roads are too wide and many are too narrow, and those that are too narrow are restricted in width by reason of the law which requires the others to be too wide. It may be claimed that, both in rural and urban territory, a general average of 66 feet is wide enough for all purposes and that no community, even when comparatively closely settled, can afford to lay out and pave streets of a greater average width. This question may not affect the farmer except in so far as he may have to contribute towards an inconvenient and expensive road system in connection with the urban development in rural territory. It is in this connection that the grievance of bad road planning becomes acute. First, the alignment is fixed without regard to contours, and, second, the width is determined on a minimum basis for all roads no matter for what purpose they are to be used.

The minimum standard in Ontario and elsewhere is 66 feet. This standard applies to the main arterial thoroughfare required to carry heavy traffic and to the short residential street required for purely domestic needs of a few houses. In many districts acres of macadam, asphalt and concrete are laid in a few streets and might with advantage be used over twice the length of street now paved. One consequence of this irrational and expensive method is that the cost of local improvements to the local councils in many localities is so great that money is not available for necessary purposes of public sanitation. Another is that the tax burden on the property owners is so heavy that they are proportionably limited in the capital available for making their houses sanitary and durable in construction, and they are compelled to crowd their land with buildings in order to put it to economic use.

Too Much Road Space

But even at this late day, with all the lessons we have had of waste of land and unnecessary expenditure of capital in providing for too wide roads for purely local traffic—in providing many miles of road space where it is not needed at all, and in thus lessening the ability of provincial and local authorities to obtain the space and provide the means to construct main arterial highways where these are required—there are those who regard any suggestion to make streets narrower than 60 or 66 feet as reactionary. Yet there are few who will deny that it is impracticable, in any community where the density of building is comparatively open, as in Canada, to provide land and make satisfactory roads or streets to a greater average width than 66 feet. What happens is that the land is provided for roads or streets, as the law requires, but that few of the roads or streets are ever properly constructed, the reason being that there is too much road surface for the population, even when the land is closely settled. Excessively wide streets, instead of securing more air space, cause congestion, e.g., in the erection of apartment houses in towns because without such congestion the frontages could not afford to meet the cost of local improvements. This has been proved in Germany, Sweden, and other countries where the tenement system prevails, and it is being proved in Canada, where the tendency towards the tenement building is being created by the wide street. In the rural districts, although land is plentiful and cheap, it stands to reason that all roads should not be of the same width, and that there should be variation to suit the requirements of traffic.

No Justification for 66 Ft. Minimum

What happens in practice is that our by-laws fix a width, not according to scientific theory, nor yet on any practical basis, but simply because of the convenience of making a hard and fast rule in accordance with some custom. The 66 feet width in Ontario seems to have no other justification than the fact that it is the length of a chain: It is about half the width that should be provided for some main arteries, and about twice what is necessary for the short tributary streets. It is true that, in the absence of proper development schemes, we must have a system of regulations fixing a general standard in these matters—that is the inevitable weakness of the by-law system—but it is quite as absurd to regulate the width of a street according to a fixed by-law standard as it would be to prescribe that all sewers and water-mains should be of the same diameter.

Maximum Convenience, Minimum Cost

Roads and streets have to be planned, in all respects, so as to obtain the maximum of convenience at the minimum of cost. Even when that principle is acted upon, the tax which industry has to meet to obtain adequate means of communication is as much as it can bear. The comparatively narrow standards of road width in Britain, 36 to 45 feet, even when accompanied

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by having the roads in the position best adapted for cheap construction, and by having only a sufficient number of roads as are necessary, seem to be as much as can be paid for by a reasonable tax on the community.

The ambition on this continent to have over fifty per cent. greater width than the British standard, with a more scattered and less wealthy rural population, has meant, in practice, that we have more road space than we need or can properly use, and that, even with the assistance of the provincial governments, only a small proportion can be paved. The absence of planning also results, in many instances, in political influence, rather than the general benefit of the community, being the guiding factor in determining which roads will be improved at the public expense. To say that a 66-foot minimum is desirable may be true, if it were possible for the community to construct and maintain that minimum. One might also say that it is desirable that every farmer should have a water supply under pressure, a bath room and a motor car, even if they are beyond his means. But should he be compelled to have these things before he is permitted to occupy a farm?

Not Planned Beforehand

The chief difficulty in getting the public to realize the economic absurdity of a 66-foot minimum is due to the fact that the ultimate cost of making and maintaining a proper surface and other improvements is ignored when the streets are laid out, and that proper expert knowledge is not applied to planning a comprehensive system of highways. Highways should vary from the narrow carriage drive of 24 feet to the wide main thoroughfare of over 100 feet in width, and the character of the development permitted on the land fronting the highway should be controlled so as to secure that the buildings will have proper relation to the character and width of the highway. As already pointed out, air space is a separate matter and should be settled by other means than by fixing widths of the highways. It is erroneous to assume that costly paved streets are needed to provide air space: the required air space round buildings can be more cheaply and effectively provided on the lot by means of building regulations.

At present there are no figures available to enable any estimate to be made of the loss which farmers suffer as a result of the present system so far as purely rural highways are concerned. But it is apparent to everyone that there are more highways and more space in the highways than the farming population can construct and maintain, and that there is incalculable loss due to the want of well-paved roads. It has been shown that the rural system of highways is the basis on which the urban system is developed. The market roads which connect the country with the town usually lead through scattered suburban areas and are often too narrow and badly made.

Suburban Standards Too High

It is important that the street planning of suburban areas should be based on sound economic principles. Streets in small towns and suburbs are usually unpaved or too extravagantly paved. There seems to be no adequate appreciation of the necessity for spreading the money spent in local improvements over as much surface as possible, having due regard to the construction being reasonably adequate. We are prone to act in this matter as we do in regard to widths and numbers of roads—we place our standards too high and then, because we find the attainment of that standard too costly, we prefer to do without improvements rather than lower it. We act like a man who is in need of boots and has only five dollars available to purchase them, but who has decided that, unless he can get ten dollar boots, he will continue to use his old ones or go barefooted.

In many suburban areas, where asphalt pavements are laid, an ordinary cheap macadam road would serve the purpose better, and concrete sidewalks are an unnecessary extravagance. The majority of residential streets in excess of 40 feet in width represent so much waste land, pavement, sewer and water connections, etc. Every unnecessary foot adds to the cost of sewerage and sewage disposal, water supply, fire prevention, policing, street transportation, and other public services. It is not too extravagant to estimate that most towns and suburbs cover twice the area they need cover under a proper system of development, and increase the burden of taxation accordingly.

Pouring Replacing Troweling for Joints of Vitrified Sewer Pipe

INDICATIONS point toward a radical change of practice in the joining of vitrified sewer pipe, partly as the result of drastic official tests for house drainage, carried out in some localities. The innovation is not a matter of joint material, but simply the substitution of a pouring process for that of hand troweling.

Among the advantages claimed for the new method are speed of operation and economy of material, besides dispensing with the need of special skill. There is less working room required in the trench and the completed joint, is apparently more impervious than is the case when the cement is moulded at a thicker consistency.

Against these advantages must be reckoned the investment in joint molds, which are clamped around the joints and must remain in place during the process of setting. Before the application of the mould, the

A Neat and Impervious Joint

joint is caulked with oakum to prevent the grout from flowing into the interior of the pipe.

Several moulds to accomplish the purpose have been designed and patented. The one used in a recent series of tests by the Sewer Pipe Manufacturers' Association consisted of a series of galvanized sheet iron sections overlapping like scales and strung on two small steel cables which clamp around the two sections of pipe to be joined during the pouring operation and afford a degree of rigidity for the line of pipe during the time of setting. The grout is poured into a funnel at the top of the mould.

The tests referred to were conducted with the two-fold object of determining the imperviousness of the joint and testing the comparative merit of various consistencies of grout. It was found that a mixture only slightly less ductile than thick cream was about the right consistency. A one and one mixture of portland cement and sharp sand of medium fineness, such as is used in the final grouting of a brick pavement, made the best showing. Every joint poured with this mixture was impervious, withstanding a test of fifteen pounds per square inch without so much as a seep.

Two joints poured with cement of the consistency of mush had flaws at the lower side of the joint, showing that the thicker cement had failed to penetrate to the bottom of the mould.

Wherein Poured Joint is Superior

The fact is pointed out that the cement in a hand troweled joint will occasionally sag during setting,

Pouring the Joint.

opening a leak at the under part of the joint. When this does not occur, the joint is often disturbed by manipulation of succeeding joints and the bond broken.

Cement and sand, mixed comparatively stiff, will permit seepage when set, while a thin mixture brings the aggregate into closer relationship and results in a denser joint substance.

The poured joint is neater in appearance and wastes no cement. It is not uncommon to use three times as much material in a troweled joint as the poured joint required.

The main point, however, is that the poured joint seems to afford a means by which unskilled labor, with ordinarily careful supervision, can produce a joint that will stand the most exacting tests proposed by sanitary codes, and fully satisfying the requirements of building drainage.

Flow Experiments

"The Effect of Mouth-pieces on the Flow of Water through a Submerged Short Pipe," is the title of Bulletin No. 96 of the University of Illinois Engineering Experiment Station. The bulletin presents the results of experiments on the flow of water through a submerged short pipe with and without entrance and discharge mouth-piece of a variety of angles and lengths. It treats of the loss of head which occurs when a stream contracts or expands under different conditions of flow and emphasizes the marked effect that turbulence of flow will have upon the amount of head lost. The discussion has direct bearing upon various problems in hydraulic practice which involve the contraction and expansion of a stream in flowing through passages.

Building Permits for October Show Signs of Improvement

FOR some time now there has been appearing monthly in the Contract Record a table showing the estimated cost of building work projected as indicated by building permits issued in thirty-five cities of the Dominion. Below are the figures for October. While the total values are still behind last year, it would appear that the trade is gaining rather than losing towards the end of the season, for the total increase over September is $783,069, or 27.53 per cent. Nova Scotia, New Brunswick and Saskatchewan are ahead of last year, while the other provinces show a decrease. In the city of Toronto building appears to be quite active and the lead over last year is being steadily maintained. It will be noticed that Peterboro's figures are the highest in the Dominion, and out of all proportion as compared with those of the same month last year, but this is evidently due to the issuing of a permit in connection with the big Quaker Oats plant. Though still behind last year, Vancouver appears to be picking up and shows an increase of $196,985 over September of this year.

Estimated Cost of Building Work as Indicated by Building Permits Issued In Thirty-five Cities

			October, 1917, compared with October, 1916	
City	Oct., 1917	Oct., 1916	Increase (*)	Decrease (†)
Nova Scotia	**$101,903**	**$93,268**	* **$8,635**	* **9.26**
Halifax	55,835	87,368	† 31,533	† 36.09
Sydney	46,068	5,900	* 40,168	* 680.81
New Brunswick	**180,350**	**101,775**	* **78,575**	* **77.29**
Moncton	174,250	18,675	*155,575	* 833.07
St. John	6,100	83,100	† 77,000	† 92.66
Quebec	**475.233**	**601,449**	†**126,216**	† **20.98**
Maisonneuve	86,500	1,325	* 85,175	* 6,428.30
Montreal	227,033	352,924	†125,891	† 3.57
Quebec	77,375	156,683	† 79,308	† 50.60
Sherbrooke	3,500	20,800	† 17,300	† 83.17
Three Rivers	75,700	27,225	* 48,475	* 178.05
Westmount	5,125	42,492	† 37,367	† 87.94
Ontario	**2,248,786**	**2,262,957**	† **14,171**	† **.63**
Brantford	21,965	11,240	* 10,725	* 95.42
Fort William	8,900	1,350	* 7,550	* 559.26
Guelph	5,685	11,280	† 5,595	† 49.60
Hamilton	197,495	194,865	* 2,630	* 1.35
Kingston	18,132	13,517	4,615	34.13
Kitchener	15,275	61,515	† 46,240	† 75.17
London	143,460	110,145	* 33,315	* 30.25
Ottawa	93,625	265,250	†171,625	† 64.70
Peterborough	817,875	5,890	*811,985	*13,785.82
Port Arthur	830	857,858	†857,028	† 99.90
Stratford	4,529	5,829	† 1,300	† 22.30
St. Catharines	38,520	46,315	† 7,795	† 16.83
St. Thomas	2,820	19,455	† 16,635	† 85.51
Toronto	786,225	496,148	*290,077	* 58.47
Windsor	93,450	162,300	† 68,850	† 42.42
Manitoba	**74.680**	**96.600**	† **21.920**	† **22.69**
Brandon	2,380	6,900	† 4,520	† 65.51
Winnipeg	72,300	89,700	† 17,400	† 19.40
Saskatchewan	**34,925**	**51.225**	* **33.700**	* **65.79**
Moose Jaw	4,650	12,825	† 8,175	† 63.74
Regina	42,800	15,400	* 27,400	* 177.92
Saskatoon	37,475	23,000	* 14,475	* 62.93
Alberta	**212,500**	**305.750**	† **93.250**	† **30.50**
Calgary	132,000	302,500	†170,500	† 83.70
Edmonton	80,500	3,250	* 77,250	* 2,376.92
British Columbia	**248,725**	**405.050**	†**156.325**	† **38.59**
New Westminster	1,600	4,950	† 3,350	† 7.08
Vancouver	233,075	394,085	†160,110	† 40.63
Victoria	10,150	6,015	* 4,135	* 68.74
Total—35 cities	**3.627.102**	**3.918.074**	†**290.072**	† **7.43**

The town of Pointe Claire, P.Q., intends to apply to the Quebec Legislature for authority to raise $250,000 for the improvement of the waterworks and the installation of a filter system.

The Deteriorating Action of Salt and Brine on Reinforced Concrete

At the present time, when concrete structures are being erected throughout the country for all manner of purposes, it is of the greatest importance that the limitations, the durability, and the cause of the deterioration of reinforced concrete should be thoroughly understood. Within the past few years the number of reinforced concrete structures has been increasing so rapidly that to-day concrete has replaced brick and stone to a large extent. Since most of our oldest reinforced concrete is not over fifteen to eighteen years old, who can predict, from so short a period of observation, its condition twenty-five or fifty years hence?

Sea-water, one of the agents which brings about the disintegration of concrete, attracted the attention of users of cement soon after it was first employed in marine construction. Although a great deal of non-reinforced concrete has withstood the action of the sea up to the present, and will probably continue to do so, still some of it has failed.

In this article by H. J. Creighton, in the Franklin Institute Journal, the author gives a brief account of observations on the deterioration of reinforced concrete by salt and brine, which were made by him, a few years ago, while examining a large number of reinforced concrete structures in different parts of the country:

Reinforced concrete which comes in contact with brine or sea-water, unless rendered absolutely impervious, will commence to deteriorate as soon as the brine comes in contact with the reinforcing rods; for, as both iron oxide and the hydrated oxide formed by chemical reaction occupy a larger volume than the corresponding amount of iron, there will be developed an enormous expansive force which is sufficient to crack the strongest concrete and force it away from the reinforcing rods. The more porous the concrete, the more rapidly will this action take place. Indeed, the writer is familiar with cases of cinder concrete structures, in contact with brine, which have shown signs of advanced deterioration at the end of a year.

Few Effective Waterproofings

Regarding the waterproofing of concrete, it should be pointed out that an impervious concrete is probably never obtained outside the laboratory. The average concrete is practically never waterproof. Although there are many substances on the market for rendering concrete waterproof, the majority of them is far from satisfactory.

Since most concrete is more or less porous to moisture, and since iron undergoes gradual decomposition, in the presence of salt water, with consequent expansion in volume, it is to be expected that reinforced concrete which comes in contact with brine or salt and moisture will ultimately disintegrate. It is not surprising, therefore, to find throughout the country reinforced concrete piers, sea walls, and buildings in the neighborhood of the ocean in various stages of deterioration. The cracks which occur in such concrete usually run parallel to the reinforcing rods. These cracks are very narrow at first, but as the decomposition of the iron progresses they become iron-stained, gradually increase in width, and, finally, the concrete is forced so far from the reinforcing rods by the pressure of the accumulating iron oxide that large pieces of it break off.

Disintegration in Salt Storage Buildings

In many parts of the country to-day there are reinforced concrete structures housing industries that use large quantities of salt and brine, which are constantly spilled on the floors. In order to ascertain whether the concrete of such buildings has undergone any deterioration, the writer a few years ago examined a large number of them in different cities throughout the country. In practically all the buildings inspected, reinforced concrete floors which came in contact with brine had iron-stained cracks on the under side. Usually these cracks were very narrow, but they indicated, nevertheless, deterioration of the reinforcements, and would continue to grow as the disintegration of the iron progressed. In many instances the cracks were found to vary from ⅛ to ¼ inch in width, and in some cases deterioration had progressed so far that large pieces of concrete had fallen, or were about to fall, leaving the badly corroded reinforcements exposed. An examination of a number of pieces of this fallen concrete showed that in every case a quantity of iron oxide adhered to the concrete where it had come in contact with the reinforcing rods, and that it was sometimes as thick as ⅛ inch. Where the concrete had broken away from the reinforcements, the latter were usually so badly corroded that it was possible to remove thick layers of oxide with the fingers. In a few cases the deterioration had progressed to such an extent that the reinforcements had been completely converted into oxide.

A few details regarding particular cases of deterioration met with in some of the reinforced concrete structures examined may be of interest.

Reinforcement Exposed

The ceiling of a machine shop of a large reinforced concrete plant in East St. Louis was found to be very badly damaged. This building, at the time of inspection, was about ten years old. The upper side of the ceiling was continually wet with brine, which constantly leaked through to the under side and wetted it in a number of places. On this ceiling large, brown iron-stains were numerous and in at least twenty places pieces of concrete had fallen, leaving badly corroded, net-iron reinforcements exposed. In one place a piece of concrete twelve feet long and varying from two to eighteen inches in width had broken away. The reinforcements of this ceiling were imbedded at a depth of about ¾ inch from the surface.

At a plant in Kansas City there was found a very interesting cracked reinforced concrete pillar which supported a reinforced concrete platform at the top of an outside staircase. Large quantities of salt were used in the plant, and the platform was often wet with brine. The cracks on the pillar ran parallel to the longitudinal reinforcing rods. In some places the concrete had fallen away from the rods, which were badly corroded, and in others portions of the concrete were easily pulled away.

At another plant in this city there was a long outside platform, from which cars were loaded, covered by a reinforced concrete roof. At one end of this roof there was a pile of rock salt, which was partially protected from the weather by a wooden roof. Rock salt had been stored in this place for years. For a number of yards beyond where the salt was stored it had been spilled continually on the concrete roof, and, owing to rains, perhaps a quarter of the roof was frequently wet with dilute brine. On the under side of the roof, directly below this place, there were many brown iron-stains, wet patches, salt deposits, and in one place the concrete had fallen, leaving the net-iron reinforcing exposed. These had deteriorated to such an extent that the outer portions crumbled on touching and some of the rods were easily pulled away. The area from which the concrete had fallen was at least one square foot. The individual rods of the exposed net-reinforcing, originally about 1/8 inch in diameter, had increased to about 1/4 inch in diameter, owing to the conversion of the iron into oxide. Some of these rods had disintegrated to such a degree that the sound iron core was less than 1/25 inch in diameter. Near where the concrete had fallen, it was evident that the expanding reinforcings were gradually forcing the concrete downwards. At the far end of the ceiling, where salt had not been spilled above, there was no evidence of deterioration and the concrete was in an excellent condition.

Pieces of Concrete Easily Removed

At a third plant in Kansas City, a five-year-old, reinforced concrete, basement ceiling was found to be in a very bad condition. This ceiling was reinforced with 3/4-inch twisted iron rods. The floor above was more or less wet all the time, and, in places, salt came in contact with the water, forming brine. There were many cracks on this ceiling, some of which were sufficiently wide to insert a lead-pencil. One such crack was twenty to thirty feet in length. In several places large pieces of concrete had fallen, leaving corroded reinforcements exposed. In one place a large piece of concrete which was almost dropping and which weighed about twenty-five pounds was easily pulled away from the reinforcements. The under side of this, as is usually the case, had a large portion of the corroded reinforcements adhering to it.

The writer examined a building in Kansas City which contained a large quantity of reinforced cinder concrete that came into contact with considerable amounts of brine. This concrete, which was thirty years old, was in a very damaged condition, and in many places very large pieces had fallen.

In one of the Chicago plants examined, a whole floor had collapsed about a year previously, owing to the weakening of the reinforcements by disintegration.

When concrete construction is carried out in winter, it is sometimes the practice to add salt to the concrete to prevent freezing, often as much as twenty per cent. being added. The writer has examined a number of reinforced concrete structures where salt had been mixed with the concrete during construction. As is to be expected, where the concrete comes in contact with water or moisture, there are manifold evidences of deterioration; but, on the other hand, where the concrete has been kept dry no damage has been observed.

Conclusions

The following conclusions are drawn by the writer from his investigations of the action of salt and brine on reinforced concrete:

1. All concrete which is not waterproofed in some way is more or less porous to water and brine.

2. Brine readily penetrates to the reinforcements, on which it exerts a disintegrating action that, owing to the attendant expansion, gradually weaken the concrete, causing it to crack and split, and in some cases to fall away from the reinforcements.

3. The more porous the concrete, the more rapid the disintegration of the reinforcements through the action of brine.

4. Reinforced concrete floors which come in contact with brine will gradually develop leaks. These will be followed by incrustations of discolored salt on the under side, where, later, iron-stained, hair cracks will develop running parallel to the reinforcements. As the deterioration progresses, the cracks will widen and, owing to the great expansive force of the accumulating iron oxide, the concrete will be gradually pushed from the corroded reinforcements and ultimately fall.

Why Rubber Belting Excels

By A. A. Briggs*

RUBBER belting has pretty well established the reputation of possessing the greatest degree of efficiency for the transmission of power, and the elevation or conveyance of any kind of material, regardless of the conditions under which it is used. Its simplicity of construction, the suitability of the materials embodied in it, the great tensile strength, and the constant uniformity, account for this efficiency.

Its basis of strength is to be found in the weight and weave of the cotton duck; and its life and durability are assured by the use of rubber friction—this combination forming a practically inseparable unit of thoroughly waterproof material. Three things, therefore, generally determine the quality and relative values of rubber belts; weight and weave of duck; quality and quantity of rubber friction; number of plies.

The Purpose of the Rubber

While the duck serves as the basis of strength in a rubber belt, the rubber friction performs these important functions:

1. Forms the whole into an inseparable unit and prevents separation of the plies.

2. Minimizes internal chafing due to the constant bending of the belt.

3. Waterproofs the duck and makes it immune to the entrance of moisture.

4. Gives pliability and ensures a natural pulley cling not possessed by belts made from any other material.

Rubber contains more vital properties when used in the making of belts than any other kind of material does. Unlike leather, the rubber belt is not immediately affected by change of temperature, humidity, steam or water. While rubber belts are not elastic, they are pliable, giving and contracting sufficiently to avoid injury or a consequent shortening of life and tensile strength. Cold weather stiffens leather and other kinds of belts, and no amount of lubricating

* Of Dunlop Tire & Rubber Goods Co., Toronto.

material will overcome this deficiency; while under the same conditions rubber retains its pliability.

Rubber Belts Have Better Cling

Rubber belts grip the pulleys constantly, because rubber has that natural pulley cling. They stand the test year in and year out. They present a perfectly smooth surface to the pulley, and the great adhesion thus secured renders the transmission of power correspondingly larger. The power-saving ability of a rubber belt is recognized by all users.

Under proper conditions the rubber belt will last much longer than any other kind. Its great strength will withstand severe and unusual strain. The evenness of surface, uniform strength, thickness and weight, pliability and freedom from twist, make rubber belting the most efficient medium for the economical transmission of power known to the engineering world.

Reinforced Gypsum Roofs

Cast-in-Place Slabs on Paper Mill Buildings Required New Methods of Handling and Mixing the Material

A ROOF slab of reinforced gypsum cast in place has just been completed on a new beater house of the Scott Paper Company at Chester, Pa. This roof, in connection with which new methods were developed for handling and mixing the material, is described in Engineering News-Record. It is the second of two such roofs that the company now has. The first was constructed last winter, in cold February weather, over a paper-machine house. This is a flat roof, 47 x 180 ft., sloping ¾ in. per ft., while the beater-house roof, 45 x 157 ft., is a ¼ pitch roof with monitor, sloping 6 in. per ft.

Both buildings have reinforced-concrete frame, steel roof trusses, steel purlins spaced 6 to 6½ ft., and were intended to be roofed with reinforced-concrete slabs across the purlins. But during erection the officials of the paper company began to fear trouble with condensation on the under surface of the roof slabs, and, in conjunction with the architect, they looked around for a roof material likely to be free from such objection. Gypsum was finally settled on as the most desirable. The contractor, the Cummings Structural Concrete Company, of Pittsburgh, agreed to undertake cast-in-place construction instead of laying premolded gypsum blocks.

New Methods Had to Be Worked Out

New methods had to be worked out for handling and mixing the material, for form construction, and for order of procedure. Experience elsewhere in casting gypsum blocks was drawn upon, and early trouble with forms sticking and having to be chopped out—because of using rough lumber and giving the vertical surfaces of the T-beams no draft—soon taught the need for special care.

The contract for the gypsum roof was taken at the price previously accepted for the reinforced-concrete roof. Whether or not the contractor lost money under this arrangement is not known. The design was made by ordinary reinforced-concrete beam formulas, but with lower compression—300 pounds per square inch—while the steel tension was held at 16,000 pounds per square inch. The T-beam stems are a trifle over 2 in. wide, and are spaced 6 in. centre to centre.

The gypsum was used neat—as a water paste without sand or stone. It was mixed to the consistency of a batter or thin paste.

Set in 15 Minutes

The mixing equipment consisted of a metal ash can and a stirrer or dasher. The can was filled two-thirds full of water, a bag of gypsum was poured in, and the dasher was worked quickly to get a uniform paste. Then the mixture was poured into the form and the surface screeded off without delay, for within fifteen minutes the gypsum set so hard that forms could be stripped if desired and men could walk on the slab.

The forms consisted of a tight floor of matched boards, and lengths of dressed 2 x 4 stock nailed on flatwise, 6 in. on centres to core out the spaces between the T-beam stems. These cores were dressed to ½ in. draft on sides and ends. The form was shellacked and sandpapered, like a foundry pattern, and before use was brushed with a clear oil (press oil), using a long-handled whitewash brush.

The roof was placed in strips 3 ft. wide running across the building, the same direction as the T-beams. The open side of the strip was closed off by a bulkhead plank whose width was just the thickness of the slab, so that a screed moved along the bulkhead would true the gypsum to the proper surface. In each T-beam stem was laid a ¼ in. rod, supported on little precast blocks of gypsum; these rods formed the sole reinforcement of the roof. Over the tops of the T-stems was laid a 3 ft. strip of wire mesh as bonding steel to restrain the expansion of the gypsum. The form was then ready for pouring.

Required Quick Work

Pouring was done in one continuous operation for the 3 ft. strip clear across the building, about 50 ft. In smooth operation it took less than an hour to cast the strip, but during this time the first part of the strip had set hard before the last part was poured.

A sufficient number of bags of gypsum for one strip was brought up by hoist from the box-car in which it was received on the job, and the bags were set up in a row along the edge of the strip about to be cast, standing on the strip finished last. They were then untied, making all ready for quick work. Mixing, pouring, and screeding proceeded in regular order until the strip was completed.

It was found necessary to use the gypsum fresh. If allowed to stand some weeks before use its setting power was reduced considerably.

Steep Pitch Introduces Complications

Construction of the beater-house roof, during the past month, went on in the same way as just described, except for complications introduced by the steep pitch. Stepped platforms had to be set on the roof to give a working floor, and the soft gypsum paste had to be held from flowing down. For the latter purpose top forms were not successful; the thin paste came up like water through any crevice or hole. But by holding a bulkhead board on top of the screeded surface of the slab just poured, and pouring the paste from a pail against the face of this board, the gypsum was held, and could be spread out upward along the roof the moment it thickened enough to hold shape. Pouring a strip was begun at the gutter and proceeded up to the ridge, this being the same as was done in the case of the flat-pitch roof. Each of the two roofs required about ten days for the gypsum work. As already stated, forms could be taken down early, and only four sets—3 ft. strips—of form were provided.

A Story of Industrial Efficiency

The Mechanical Appliance Company, Milwaukee, through Mr. W. A. Buchanan, their Toronto office manager, have forwarded us a valuable booklet, entitled "A Story of Industrial Efficiency." This booklet contains some very interesting information on a particular plant, which information is, however, applicable to other plants. The scope of the booklet may be the better understood from the following chapter topics: Ball bearing motors; full poppet valve engine; engine lubrication; boilers and accompanying equipment; superheat; pipe covering; electric lighting; kiln-drying lumber; efficiencies effected—these all having reference to the Rockwell Manufacturing Company, manufacturers of doors, sash, blinds, glazed windows, mouldings, floorings, etc. A number of interesting illustrations are also shown. One of the most interesting sections is an appendix containing an analysis of the power, lighting, and heating costs of this company for the year 1916. The cost of motor drive as compared with operation by steam equipment previously used shows a saving of 41.4 per cent.; at which rate the new plant is paying for itself in approximately two years and five months. As a particular example of the savings effected, it is pointed out that the entire cost of operating the new equipment, including 15 per cent. on the investment, is only slightly in excess of the coal bill alone under the former conditions.

Mainly Constructional

East and West—From Coast to Coast

Ioco, B.C., is agitating for a passable road to and from Port Moody round the head of the Inlet. Surveys, plans and reports have been made, but the government is still delaying action.

The rural municipality of Westbourne, Man., has adopted a good roads scheme under the Provincial Good Roads Act and a comprehensive plan of highway improvement has been formulated.

The oil flotation mill to be built near Penticton by the Canada Copper Company, will cost nearly $2,000,000, and will be finished in a year. It is estimated that the assured ore measures 10,000,000 tons.

The building permits issued in Sydney, N.S., in the month of October show a very great increase in value as compared with the corresponding month in 1916. The figures are $46,068 and $5,700 respectively.

The Moncton, N.B., city council have decided to repair one thousand feet of road between the Albert Street hill and Coverdale bridge, the materials to be used consisting of brush and mud to a depth of five feet.

The Mullen Coal Company has acquired a new dock property near the old fish hatchery in Sandwich, Ont., and has let the contract for the necessary work to the Great Lakes Dredging Company, which is starting on the big wharves for the Canadian Steel Corporation at Ojibway.

The factory at Niagara Falls, Ont., jointly occupied by the Davis-Bournonville Company and the Davis Acetylene Company has been taken over by the first named concern and will be operated exclusively for the manufacture of oxy-acetylene apparatus for the Canadian trade.

Paul E. Mercier, chief city engineer, Montreal, reports to the Board of Control that the new motor sweepers puchased by the city are difficult to operate and slow. It has been found that on rough streets the sweeper is so badly adjusted that it leaves material in the holes and depressions which it should have swept up. The daily operating cost has amounted to $17 to $23 for twenty-four hours.

Lord Shaughnessy, President of the C. P. R., Howard G. Kelly, of the Grand Trunk Railway System, Sir Wm. Mackenzie, of the C. N. R., and A. H. Smith, of the New York Central Railway, will head the Canadian Railway Association for National Defence, recently organized at the suggestion of the Canadian Government, to secure a closer co-operation among the Canadian railways, and which will have the authority to formulate a policy for the co-ordinating of industrial activities for the prosecution of the war.

It is probable that the Crawford Street extension scheme in Toronto, which includes the acquisition and filling in of Sully Crescent, will be proceeded with early next year. The scheme has been under way for over three years, but was halted on account of the war. The Civic Works Committee now, however, recommend that the council allow Street Commissioner Wilson to use the site for the dumping of ashes and that funds for the purchase of the houses that will have to be demolished be provided in next year's estimates.

On November 26 a by-law will be submitted to the ratepayers of Whitby, Ont., regarding the establishment of a factory in that town by the United Rubber Manufacturing & Reclaiming Company, Limited, of Toronto. Under the terms of the agreement the company is to erect a building 60 x 160 feet, the total cost of which when completely equipped is to be $50,000, while the town will loan the firm $25,000, allow tax exemption privileges and grant fixed assessment of $10,000 for ten years. The factory is to be ready for operation about March 1, 1918.

According to the statement of Mr. J. R. W. Ambrose, chief engineer of the Toronto Terminals, the outside work on the new union station at Toronto will be completed probably by the end of the year, but the offices and platforms within may not be finished for another year, due primarily to the exigencies of the war, the quarries now working on a somewhat irregular basis, and supplies from the United States and other outside markets, coming in very slowly. When completed, the new depot will have a length of approximately 750 feet and a depth of 600 feet, and will comprise 11 platforms, each capable of accommodating at one time two incoming and two outgoing trains.

Personals

Mr. E. O. Ewing has resigned from the staff of James, Loudon & Hertzberg, Limited, and joined the University Officers' Training Corps.

Lieut. C. J. Dryden, of the C. J. Dryden Company, contractors, Westmount, P.Q., has been wounded and is now in hospital in England. He left Canada with a pioneer battalion, and was transferred to the 85th Battalion, a Nova Scotia Highland unit.

Mr. R. J. McClelland, city engineer of Kingston, Ont., at the end of last month completed his fifteenth year in the service of that city. He entered the city engineer's department in 1902 and in 1905 was appointed assistant city engineer. Since his promotion to his present position in December, 1911, he has carried out a great deal of improvement work, including the construction of all the permanent pavement in the city with the exception of one block.

Obituary

Mr. Geo. W. Hunter, who up until some years ago had carried on a building business in the city of Toronto, recently passed away. The late Mr. Hunter was born in Scotland and came to Canada with his parents at the age of nine years. Since 1881 he lived permanently in Toronto, and was engaged in the building trade until he retired some years ago.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Sault Ste. Marie, Ont.
City Council contemplate the construction of a sewer, costing $8,300, on Queen Street, between Pim and Gore Streets; also between Elgin and March. Engineer, W. L. McFaul.

CONTRACTS AWARDED

Fullarton Township, Ont.
Mr. Ruston, Milverton, has the general contract for drain and culvert for the Township Council.

Grand Prairie, Alta.
H. G. Jamieson has the general contract for tower and water system for the Town Council.

Hibbert Township, Ont.
Mr. Crowley, Rostock, has the general contract for drainage work, costing $8,000, for the Township Council.

Hullett Township, Ont.
August Guhr, Brussels, has the general contract for drainage work, costing $33,000, for the Township Council.

Grand Mere, Que.
Alexander Carrier and J. Jacobs, Ste. Tite de Champlain, have the contract for the construction of a gravel and concrete highway, costing $300,000, from here to Three Rivers for the Grand Mere, Three Rivers Highway Company, Ltd., Grand Mere.

Sydney, N.S.
A. E. Cunningham, Union Street, has the general contract for sewer on Townsend Street, costing between $5,000 and $6,000, for the City Council.

Railroads, Bridges and Wharves

Chin, Alta.
The Irrigation Department, Canadian Pacific Railway, Calgary, have nearly finished survey for canal to irrigate 7,000 acres of land.

New Dayton, Alta.
The Canadian Pacific Railway, head office Montreal, contemplate the erection of a depot. Address Mr. Cotterell, C.P. R. Station, Calgary, or Board of Trade, New Dayton.

St. John, N.B.
City Council contemplate repairs to wharf, costing $30,000. Engineer, T. W. Russell.

CONTRACTS AWARDED

North Vancouver, B.C.
The Dominion Construction Company, 509 Richards St., Vancouver, have the general contract and are in the market for supply of lumber, tension rods, bolts, spikes, etc., for the erection of a $7,895 timber bridge for the Municipalities of North and West Vancouver.

Public Buildings, Churches and Schools

Dartmouth, N.S.
School Board contemplate the erection of a school. Secretary, Alfred Elliott.

Evansburgh, Alta.
Plans are being prepared for a school for the Evansburgh Public School District. Address secretary-treasurer.

Fredericton, N.B.
Tenders received by the Military Hospital Commission, 22 Vittoria St., Ottawa, until November 26 for the erection of a frame and pressed brick vocational building. Architect, Capt. W. L. Symons.

Hamilton, Ont.
The Board of Education contemplate the erection of school on Melrose Ave. Secretary, R. H. Foster, 18 Cottage Ave.

The Soldiers' Aid Commission are having plans prepared for a hospital which they will probably erect near here. Local secretary, A. W. Kaye, 22 Main St. W.

London, Ont.
The Western Fair Board contemplate the erection of a $10,000 fair building. Secretary-treasurer, A. M. Hunt, Dominion Savings Building.

Nobleford, Alta.
The Knights of Pythias have secured a site on Main Street, on which they plan to erect a lodge hall.

St. Anne de Bellevue, Que.
E. G. M. Cape & Co., Ltd., 10 Cathcart St., Montreal, general contractors for $200,000 hospital for the Military Hospital Commissioners, Drummond Building, Montreal, are in the market for a quantity of building material.

St. John, N.B.
Tenders will be called about Nov. 30 for the erection of a brick construction tuberculosis hospital for the Military Hospital Commission, 22 Vittoria St., Ottawa. Architect, Capt. W. L. Symons.

South Wellington, B.C.
Tenders received by the minister, J. E. Griffith, Victoria, until noon Nov. 27 for the erection of a four-room school for the Department of Public Works, Provincial Government.

Toronto, Ont.
The Military Hospital Commission, 1 Queen's Park, will erect a frame hospital at High Park. Purchasing agent, Lieut. T. Harbron.

Verdun, Que.
Tenders will be called by the architect, J. E. A. Benoit, 1200 Wellington St., in December for the erection of a $175,000 three-storey stone and brick school for the School Commissioners.

Windsor, Ont.
The School Board are receiving competitive plans for a school, costing about $100,000. Chairman of Building Commission, A. G. Roberts, Labelle Building.

CONTRACTS AWARDED

Brantford, Ont.
T. H. Harper, 14 Jarvis St., has the general contract for $3,500 brick extension to hall for the Salvation Army.

Calgary Alta.
The following contracts have been awarded in connection with the erection of a nurses' home, costing $15,000 for the Hospital Board: General contract, Bennett & White Construction Company, 100 City Hall Corner; electrical work, Cunningham Electric Company, L. and Lepper, 1751 Seventh Avenue N.W.; metal lath and plastering, H. Ward 1335 Montreal Ave. The general contractors, Bennett & White Construction Company, 100 City Hall Corner, will carry out the carpentry and roofing.

Fredericton, N.B.
Scott & Forbes have the general contract for military hospital for the Military Hospital Commission, 22 Vittoria St., Ottawa.

Steve B. Brown, 125 King St., has the painting contract for hospital building and government house, costing between $80,000 and $100,000, for the Dominion Government.

Glace Bay, N.S.
Wilmot Guthro, Alexander St., has the plumbing and heating contracts, costing $6,500, for convent and chapel for the Roman Catholic Corporation of Antigonish.

Hamilton, Ont.
J. J. Giles, 451 Aberdeen Ave., has the general contract, will carry out the masonry, steel, carpentry, and roofing and let plumbing, heating, plastering, painting, and electrical work for $8,000 parish hall for the Polish church, corner Grey and St. Joseph Streets.

Maisonneuve, Que.
The Montreal Architectural Iron Works, 157 Prince St., Montreal, have the ornamental iron and H. Truchon, 1030 Bordeaux St., Montreal, the electrical work for $175,000 school for the Roman Catholic School Commissioners, 87 Catherine W.

Montreal North, Que.
The following contracts have been awarded in connection with the erection of two schools, costing $100,000, for the Roman Catholic School Commissioners: Carpentry, Dusseault & Piquette, care of general contractor; roofing, plumbing, and heating, J. E. Hardie, 666 Papineau Ave.; plastering, P. Larocque, 341 De Lanaudiere St.; painting, Nap. Gignac, 85 De Lanaudiere St.; hyloplate blackboards, E. N. Moyer Company, Ltd., 118 Richmond St. W., Toronto. The general contractors, Grothe & Pion, 70 St. James St., will carry out the masonry and steel.

Montreal, Que.
The following contracts have been awarded in connection with the erection of a $75,000 addition to building for Provincial Government, Quebec: Roofing, Gustave Fontaine, 210 Plessis St.; elec-

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Principal Contents

Page

Road Planning Necessary

THE article by Mr. Thomas Adams, town planning adviser of the Commission of Conservation, in last week's Contract Record, contains many good ideas about road planning. It is the author's contention that most roads are too wide and many are too narrow, and he advances several arguments in substantiation of his claim that a 66 ft. minimum width is not justifiable. Road surveyors in Canada — and, indeed, on this entire continent — adhere rigidly to an artificial system of planning rather than submit to the guiding principles of human necessity and the traffic requirements of the whole population. The result has been that position, alignment, directness, and width have not been sufficiently considered through adherence to a stereotyped plan of rectangularly laid-out highways. No extended investigation is necessary to demonstrate the absurdity of the grid-iron plan which leaves out of all regard the need of direct routing, avoidance of sharp corners and bad grades, and the necessity of linking up community centres by radial thoroughfares. Such lack of foresight has overrun the country with roads at intervals of every mile or so, with the result that, as stated in the Conservation Commission's report, "there are too many roads in Canada, because there are more roads than it is possible to make out of the funds likely to be available on the basis of the most liberal estimate of the tax-paying ability of the people."

The present unscientific system of fixing the road alignment is accompanied by an equally absurd system of fixing road widths. The width has been very largely determined on a minimum basis for all roads, irrespective of their purpose. The selection of this minimum 66 ft. in the greater part of the country is solely a part of the stereotyped practices that have characterized all our road planning endeavors. The lay-out of most roads has been governed by this empirically determined width and not, as should be, by the traffic requirements and local conditions.

In consequence, we have to-day more road surface than can ever be properly surfaced and maintained by the money available. Comprehensive systems of highways, including through arteries, are precluded by the necessity of keeping up wide secondary highways. The expense attached to the maintenance of such roads forbids the proper expenditure for such essential purposes as public sanitation. Mr. Adams believes, further, that wide streets, instead of securing, as might be thought, more air space, cause congestion through the erection of tenements or apartment houses on small frontages in order to more adequately afford the cost of local improvements.

From many viewpoints the absurdity of a 66 ft. minimum is evident. British standards, involving far narrower streets than are the case in Canada, have been found to be as much as can be financed by reasonable taxes. In Canada, then, with its more widely spread population, highways uniformly 66 ft. wide are opposed to the best economic interests. In short, to realize the essential requirements of every road planning scheme —maximum convenience at minimum cost—there must be a realization of the absurdity of the 66 ft. minimum.

Canadian Engineers and Contractors Can Help in After-War Reconstruction

MR. J. A. L. WADDELL, the well-known consulting bridge engineer, writes to our contemporary, Engineering and Contracting, advocating an international alliance of engineers, contractors, and manufacturers for reconstruction work after the war. A French engineer whom he quotes in his letter, suggests the collaboration of American supplymen, engineers, and capitalists with the French organization for reconstruction. In reorganizing the devastated regions the French engineers will wish to avail themselves not only of American materials, but also of American experience, methods of rapid work, and means of action, and it is for this reason that collaboration is invited. It seems to the Contract Record that Canadian engineers, contractors, and furnishers of materials can participate in such an alliance. By reason of her share in the liberation of France from the first day of war, Canada has a moral right to at least fraternally assist the other allies in the work of rebuilding. The manufacturers and engineers of this country have been urged to prepare for the day of reconstruction; and, if these forewarnings have not been without effect, they ought to be ready to share in this work that is bound to come with the day of peace. To indicate the opening that is presented, we reprint herewith Mr. Waddell's letter:

"For some time I have been in correspondence with certain prominent French engineers concerning professional matters relating to reconstruction after the war. One of them, a young officer in the army now at the front, and the son of one of the best-known civil engineers of France, has been asking me various questions about how to get in touch with American engineers, contractors, and supply men. Not understanding exactly what he wanted, I furnished him with the best information I could, and asked him to explain more fully that which he had in mind. In reply I received a letter, from which, after translating, I extract the following:

"'I wish to prepare from now on the work in which I shall be able to occupy myself after the war, and specially to enter into relations with individual Americans or organizations of which I believe the collaboration to be necessary.

"'The projects in which I would like to interest this collaboration are in their great lines the following:

"'Reconstruction of certain industrial districts devastated by the war, and of which the economic life should retake an active strife. For this end there is necessary the formation of a construction company which will become conversant with the industries and the municipalities for the purchase of suitable lands and the preparation of the general conditions of work, comprising notably:

"'Contracts with furnishers of materials of construction (at a pinch, equipment of auxiliary manufactories for the preparation of these materials — bricks, timber, lime, and cement). Entente with the public powers for the establishment of surveys of towns and the study of questions relative to public services (municipal or community constructions, stations, bridges, and roads, distributions, canalization, etc.) Negotiations with companies or individuals desirous of reconstructing their shops and their residences.

"'The works of construction properly so called will be undertaken by modern methods, installations of rational storage yards, and a perfected equipment permitting of producing in series with the maximum of rapidity and the minimum of hand-labor.

"'I am convinced that the collaboration of American engineers would be specially useful to us in the reorganization of the devastated regions, on account of their experience in the matter of city planning, their methods of rapid execution, and their modern means of action.

"'In particular, they will know how to evolve suitable solutions of the problem of workmanship, of which the crisis will be very serious in Europe after the war.

"'That collaboration could be exercised—either by the adjunction of American specialists to French enterprises or by the installation in France of American enterprises to which would be joined French engineers.

"'In any case there will be the necessity of procuring an appropriate equipment of works; and by that term I mean all the outfit necessary for the works of construction of cities, to wit: Concrete mixers, cranes, derricks, aerial transporters, riveters, installations of electric power and compressed air, rolling stock, etc.

"'It will be, without doubt, advantageous to buy this material in America to supplement the materials of construction which we shall lack, such as cement, wood, and metallic constructions.

"'In resume, in order to be able to study from now on the realization of these different points, I should like to be able to enter into communication with the following persons:

"'Engineers specializing in the question of construction of private, industrial, and public buildings, and, in a general way, of city planning; contractors capable of coming to execute works in Europe; furnishers of materials of construction individuals or companies desiring to interest themselves in an enterprise of reconstruction of that kind, either in execution, or by participating in financing.'

"From the preceding it is evident that my correspondent really means business; and, consequently, I should like to put him in communication with American engineers, capitalists, contractors, and supply men, provided that these gentlemen also mean business, and that they are properly equipped financially and in other ways to do the work contemplated.

"I do not feel at liberty to mention in print my correspondent's name, but through the New York office of my firm I could put in touch with him any individual or corporation of the proper stamp desiring to correspond with him. In my opinion, as many arrangements as possible looking towards the international alliance of engineers and others herein contemplated should be made before the close of the war, so that as soon as peace is concluded the work of reconstruction may be started.

"Such a professional and financial alliance might be the means of bringing a large amount of business from Europe to this country; consequently, if there is anything I can do to aid in forming it, my services and best endeavors will be available. In self-protection, however, I must state that I do not want to get into correspondence with anyone who is merely looking for employment, nor with any promoter who is not directly able financially to help in the undertaking. My New York office address is Room 500, at 165 Broadway."

Toronto Electrical Engineers' Meeting

THERE is not at first sight the material for an extremely interesting lecture in either of the subjects of "Current Transformers," "Demand Meters" or "Relays"; nevertheless, the papers presented at the last local meeting of the A.I.E.E. drew an attendance of some sixty members of the Toronto section. Quite a new light was thrown on the subject of testing current transformers, by Mr. Harry Baker, in describing the test-ring method developed by himself, and his mastery of the subject enabled him to meet and defeat his critics without difficulty. None the less, the discussion on this paper and the succeeding one by Mr. P. A. Borden was quite an active one. In reference to this matter of maximum demand, Mr. Borden's opinion was that it is high time some standard definition was arrived at for the quantity (to say nothing of load factor, power factor, and several other terms in common use). The various forms of protective relay, together with their scope, their limitations, and their operation were described in very lucid fashion by Mr. C. W. Baker.

A large number of new applications for membership in the American Institute of Electrical Engineers is now being received, which demonstrates that our young engineers fully appreciate the necessity of maintaining their technical efficiency at the highest point. Mr. A. B. Cooper is the chairman of the local committee on membership, and will be pleased to give all possible information about the institute in response to any enquiries sent to him at 212 King Street West, Toronto.

Quebec Bridge Substructure Details Described to C. S. C. E.

THE hall of the Canadian Society of Civil Engineers, Montreal, was crowded to the limit on the night of November 22, when Lieut.-Col. C. N. Monsarrat, chairman of the Quebec Bridge Commission, described a section of the work on the Quebec Bridge. The society had invited the members of other bodies to be present, and, in view of this fact, the address was along semi-technical lines. Lieut.-Col. Monsarrat confined his description to the substructure, with incidental references to the super-structure. This latter is to be dealt with in detail on December 6 by Mr. G. F. Porter, chief engineer of the St. Lawrence Bridge Company. The address was illustrated by a large number of slides, showing methods of construction, shop work, and general views.

Mr. Walter J. Francis presided, and in the opening address remarked that, owing to the stress of the times through which we are passing, the Quebec Bridge had not received the notice it deserved. He commented on the part which Canadian engineers had taken in designing and erecting the bridge, and said that the names of Duggan, Johnson, Monsarrat, Porter, and others would be written large in the engineering annals of the world. For immensity, uniqueness of design, excellence of detail, and completeness of organization the work had rarely been equalled and never excelled in the world.

Lieut.-Col. Monsarrat's address was in the form of a running comment on the views. It was full of information and figures, presented in a way that held the attention of the audience. Much of the work, he said, was not visible to the public, as it was buried beneath the river. In removing the wreckage of the former bridge it was found that only one eye bar was broken. After removing all that was possible, some 10,000 tons of steel remained at the bottom of the St. Lawrence. A large portion of the cutting of the wreckage was done by oxy-acetylene. Borings showed that a new substructure was necessary, and that bed-rock would be encountered at 100 feet below extreme high water.

The speaker then described the construction of the caissons. The one for the north pier, built at Sillery and towed to the site, met with an accident, and had to be towed to Levis, where it was repaired and afterwards used for the south side, two smaller ones being used for the northern pier. During work in the caissons the workmen came across a large steel plate from the original bridge, and, as it could not be cut, it was carried to the bottom.

The air pressure in the caissons at the lowest point was 45 pounds, the men being able to work only two turns of one hour each daily. The rate of progress per day in the north caisson was 3 in. and in the south caisson 9 in. The contractors had to take special precautions to guard against "bends," these means of combatting the trouble including a tank where men affected could be kept under compressed air until they gradually recovered. Fortunately, there were only two or three serious cases.

Lieut.-Col. Monsarrat described in detail by means of the pictures the anchor piers, 136 ft. x 29 ft.; the method of building, bonding of the granite surfacing by means of air-surfacing machines, etc. Speaking of the shop work, he said that it was of the very best class, and this was borne out by the fact that in connecting up the central span there was not the slightest difficulty, so far as the correctness of the shop work was concerned.

In dealing with parts of the super-structure, it was stated that each section of the chord weighed 100 tons, or a total of 400 tons. Some of the pictures illustrated the building up of the castings and shoes, and showed how ten members were supported by one shoe. The pins, of nickel steel, were five feet long and weighed six tons, double pins being used in almost every instance. The posts were of immense size and strength, while the type of erecting traveller, equipped with an electric elevator, had proved to be most efficient.

On the motion of Sir John Kennedy, a vote of thanks was accorded Lieut.-Col. Monsarrat. Sir John emphasized the immense progress which had been made in constructing metal bridges, and congratulated all those who had a part in the erection of the Quebec Bridge.

Railway Builder Broke Contract

The Dominion Timber and Minerals Company, Ltd., was condemned by judgment of Mr. Justice Maclennan, in the Superior Court, to live up to their contract with Walter J. Francis and F. B. Brown, consulting engineers, by paying them on a basis of 2 per cent. of $160,000, being the cost of the construction of a railway line which the company was engaged to construct for a distance of about twelve miles at Grenville, for L. E. Moulton.

Plaintiffs complained that after being engaged in the capacity of consulting engineers by the company defendant, and after fulfilling their duties until September 7 last, they were discharged without reason.

The company admitted the engagement of plaintiffs on the basis of payment of 2 per cent. of the total cost of the construction of the line, but contended that the contract reserved the company's right to terminate the engagement at any time, even without cause.

Justice Maclennan ruled against this contention, and held that plaintiffs had proved their claim. The railway line cost $160,000, and, under the conditions of the agreement, the plaintiffs claimed they were entitled to $3,200. They received $300 before, and $500 since the institution of the action.

Judgment was now given in their favor for the balance, namely, $2,400, with interest, and costs.

Convention for Promotion of Industrial Accident Prevention

The Industrial Accident Prevention Association held a convention on November 20, in the Normal School Buildings, Toronto. Addresses and motion pictures emphasized the value of safety precautions and the need of education to prevent accidents. Some of the addresses on the program were: "Safety Committees in Modern Industry," "What Accidents Cost the Employee, the Employer, and the Nation," by Mr. C. W. Price, of the National Safety Council, Chicago; "Factory Safety Work Experience," by David Brown, plant engineer, Canadian Westinghouse Company, Hamilton; "Service Worth Its Value in Industry," by Miss Nesta C. Edwards, Kimberly-Clark Company, Neenah, Wis. H. H. Biggert, of the International Harvester Company, Hamilton, and S. Price, of the Workmen's Compensation Board, also contributed to the program.

Details of Railway Construction Camps

The Proper Methods of Housing Railway Building and Maintenance-of-Way Gangs—Careful Study of Water Supply and Sanitation

RAILWAY construction camps and the methods of housing and feeding railway building and maintenance-of-way crews were outlined in a paper by F. E. Weise, chief clerk of the engineering department, Chicago, Milwaukee, and St. Paul Railway, before the recent convention of the American Railway Bridge and Building Association. From a rather extensive and comprehensive account are excerpted the following suggestions of interest to contractors and engineers:

When it has been decided that a camp is to be established, the site of the work should be examined carefully and the location of the camp determined by considering the conditions that will make it habitable. Location, water supply, drainage, and sanitation should be given careful study.

Location and Type of Construction

If the camp is to be located on the railway company's right of way, the space may be limited, and the buildings will have to be placed in a row. If so, the office building should always be placed between the dining and the sleeping quarters. In some cases sufficient unused land is available so as to allow a more compact arrangement, and in others the physical conditions will, in large measure, control the layout. Camp buildings should be located on high ground whenever practicable, so that the natural drainage is away from the buildings and ensures rapid drying out after rains. The arrangement of the buildings and the plan of the buildings themselves will depend somewhat on the location, the material that is available for their construction, and the season of the year during which the camp is to be in use. If the camp is to be in operation during the winter as well as the summer, the buildings must be of a more substantial type that will withstand stormy weather and keep out the cold. A camp which is to be used only a few months in the summer time may be of a very temporary form of construction. Most large pieces of work requiring construction camps are apt to extend over a period of a year or more; and, while the buildings are styled temporary buildings, they must be substantially built.

All camp buildings should be built high enough above the ground to enable a man to clean up underneath. The space under the building is then easily inspected, and no old clothes or rubbish should be allowed to accumulate. In the autumn this space should be enclosed as a protection against cold. The buildings should be equipped with stoves or other heating apparatus, not only for the warmth of the occupants, but to dry the rooms out in damp weather.

The office building should be of construction similar to the other camp buildings, and large enough to provide for an office for the transaction of business and the performance of the necessary clerical work and drafting, and a storeroom for the camp supplies and the commissary. Sleeping quarters for the engineer and office force should also be provided, either in the same building, or in a lean-to communicating with it.

Dining-room and Kitchen

For the average camp the dining-room and kitchen should be in one building and separated by a partition. In the dining-room end sufficient tables should be provided so that the entire force may be served at one time. When the camp is not too large, the building should be long and narrow, the dining-room being at one end and the kitchen at the other, with entrances at each end and a communicating door between the kitchen and dining-room. The dining-room should be wide enough to provide for two long tables at the sides, with an ample aisle between, which will permit waiters to pass back and forth freely. This form of building can be loaded on a flat car and transported from one location to another. For larger camps it may be better to construct the building in the shape of a "T," in which the dining-room is one large room and the kitchen an annex at the centre of one side.

Another good plan consists of three adjoining buildings, placed in the form of a letter "U," and provides for two separate dining-rooms, with a common kitchen. This plan is desirable where the force is apt to fluctuate. When the force is small, one dining-room may be closed; and, as the work nears completion, one building may be removed without interfering with the camp routine.

Whatever the arrangement decided upon, provide liberally for windows, in order that in cold weather the dining-room will be well lighted and in hot weather the windows can be thrown open. Nothing is more conducive to cleanliness than plenty of light, and it is the common experience that rubbish will accumulate in dark places. Screens for windows and doors are an absolute necessity, and a constant effort must be made to eliminate flies, ants, roaches, and other pests. Frequent scrubbing with a liberal use of hot water and soap will be of great help, and a good rule is to scrub the kitchen every day and the dining-room twice a week. The dining-room and kitchen floors should be swept after every meal.

It is usual to provide long tables about 30 inches wide, with long benches at each side. Sometimes smaller tables are provided, seating four to six men each, but it is found that this plan requires more waiters and that the men cannot be served as quickly. It will be found more satisfactory to the men to eat at the same table with those they work with, and, therefore, each man is assigned to a definite place by the clerk in charge of the camp. The tables should be strongly built, and the top at least made of surfaced lumber, in order that it may be kept clean.

Kitchen Details

Whether the kitchen is part of the same building or not, it should communicate directly with the dining-room, but be separated from it by a partition and a screen door. There should be a door opposite the dining-room, through which supplies and fuel are received and refuse taken out. It should also be provided with plenty of windows and a ventilator, in order that the heat and odors from the range may be kept from the dining-room. In the summer time the windows and doors should be screened. The kitchen should be equipped with a range, serving table, sink for washing dishes, cupboard, shelving, and a pantry. The pantry is used to store such supplies as are required from day to day, but not in any large quantity. The large stock of supplies should at all times be kept in the storeroom that connects with the office, and the cook will draw therefrom what is needed from day to day.

The cook and his helpers should have sleeping quarters either in the main building or adjoining the dining-room, but if in the same building, they should be completely partitioned off from the dining-room and the door be kept closed.

A refrigerator should be provided, and it will be best to have this a separate building, located conveniently to the kitchen. This can easily be constructed from matched lumber.

For a camp lasting several seasons, a cellar, roofed over and covered with earth, will provide an excellent place for keeping potatoes, beets, turnips, and other vegetables.

The force required for a camp of about 150 men will consist of a cook, three flunkies, and a commissary clerk. Larger camps will require additional help in proportion. Much depends upon the cook in the conduct of the camp, not only in providing satisfactory meals, but also in keeping the expenses within proper limits.

Garbage should not be allowed to accumulate. A barrel having a tight-fitting cover should be provided, and in this all of the garbage is collected. Once a day this barrel should be taken to a considerable distance from the camp and the contents buried, or, better still, burned. A garbage incinerator can be constructed easily and cheaply, and it is by far the more desirable plan.

Water Supply

If a well of good drinking water can be secured it will be found a wonderful asset to the camp. The well should be located not nearer than 100 feet from any camp building, and preferably more, and, if possible, on a rise of ground. It should be curbed at least 1 foot above the ground level, and the surrounding space filled in with earth, to slope away from the well It should be properly covered and protected so that nothing may be thrown into it that will pollute the water. It goes without saying that outhouses and the disposal of garbage should be kept at a safe distance, not less than 200 feet away.

Sometimes a good spring is located in the near vicinity and the water can be piped to the camp. Should the camp be so located that water from a river or lake must be used, the problem becomes more serious, and extraordinary precautions must be taken to keep the water from being polluted. Water taken from a lake or river must usually be boiled before it is used for drinking.

Commissary Store

It is sometimes necessary that a commissary store be run in connection with the camp, especially when the camp is located at some distance from a town. This commissary store is to be in charge of the commissary clerk, and should carry in stock such goods as are most frequently called for and used by the men, such as overalls, shirts, socks, blankets, heavy shoes, overshoes, and standard brands of tobacco. This list may be extended as warranted in the judgment of the engineer, but in no case should it include liquor of any kind.

When a camp and commissary store are run by the railway company it is not for the purpose of making a profit, but care should be used to see that it is not run at a loss. For that reason careful accounting is necessary, and precautions should be taken to prevent petty thievery or grafting.

A commissary should not be run in competition with a local store. In the first place, the conduct of a commissary is an added care that ought to be avoided if possible, and, in the second place, it is the desire of the railroad company to encourage business along its lines. The commissary store should be run on a strictly cash basis.

Cost of Operation

It is quite customary, in determining the price to be charged for board and lodging, to charge the employee what he would have to pay ordinarily in near-by towns and then furnish as good board as possible with a view to having the camp pay for itself. The cost of the meals furnished to those employees needed to operate the camp is considered a part of the camp expense. Should there be any employees on the work whose expenses are paid by the railway company, the cost of the meals should be charged to the work and the camp given credit. At the beginning of the work the force may be comparatively small, and at the close of the work it will gradually diminish, making two periods during which the camp will not pay for itself. It should, therefore, be planned that when the force is at its maximum the camp should make some profit, in order that, when the work is closed, the accounts will about balance. In order to do this the affairs of the camp will have to be planned and watched carefully.

As a general experience a camp of 25 men or less will not pay expenses; a camp of from 50 to 75 men can be made to come out about even, and a larger camp will show a slight profit. This bears out the previous statement.

Construction of Bunk Houses

The construction of the bunk house will depend upon the locality and the season during which it is to be used. If in use during the winter, it must be built quite substantially, so as to withstand storms and cold. If the bunk house is to be used only for a few months during the summer or in very warm climates, it may be of very light construction, but it should always be so built that it will keep out the rain. It should be built high enough above the ground to enable a man to get under it, and a positive rule should be made that the space underneath be kept clean and that no accumulation of rubbish or old clothes will be allowed.

Bunk houses or sleeping quarters should not be made too large. It is much better to have a number of smaller houses than to endeavor to make one building large enough to provide for the entire force. There are apt to be disturbing factors during the night, which will disturb the entire camp if all the men are housed in one building. For the common labor it has been found desirable to have houses that will accommodate from 30 to 40 men each, although some would limit the number to 24. For the housing of sub-foremen, carpenters, and other high-grade labor, houses accommodating from 12 to 16 men are preferable.

Bunk houses, built rather long and narrow, with bunks on either side and a central aisle, appear to be the most satisfactory, and have the added advantage that they can be loaded on cars and transported to other jobs. Old car bodies, when available, may also be used. In very large camps it is at times decided to build houses that will accommodate more than 40 men, but, because of their size, they are more costly.

It is quite customary to build bunks of wood, but great improvements have been made in the last few years in the manufacture of steel bunks, and they are being installed in many camps because of their greater comfort and the ease with which they are kept clean and sanitary.

Lockers

There is one item which at first thought may seem an extravagance, but which will do much to hold the men, and that is the installation of individual lockers. Metal lockers may be deemed too expensive, but they are more sanitary. They should be in good condition when the camp is taken down, and can be used elsewhere. Wooden lockers with doors having an opening of wire mesh can be easily and cheaply constructed. They should be built in two tiers, 2 feet square and 4 feet high, large enough to hold a suitcase. Good locks, with individual keys, should be furnished. Each man is given a key, attached to a metal tag, bearing the same number as the locker. The kep is charged up to him, and he is obliged to turn it in when he leaves before receiving his pay. Lost keys are charged to the men and deducted from their pay.

Bunk houses, except in very warm climates, or when used for only a short period during summer months, should always be provided with stoves. Railway caboose stoves are well adapted to that purpose. In cold weather men must have a place to warm up, and in wet weather there is always clothing to be dried out. Sleeping quarters should not be allowed to become damp and musty.

A water barrel should be provided at each end of each camp building, for use in case of fire. In the winter time the water should be heavily salted or saturated with some anti-freezing mixture. It should be the camp man's duty to examine each barrel every day, and see that it is filled and ready for use. A pail with a rounded bottom, marked "to be used only in case of fire," should be provided for each barrel.

Electric Lighting the Ideal Arrangement

When it can be had, electricity is the ideal method of lighting a camp, and it can frequently be supplied without undue cost. The camp may be near a town having a power plant, or near some power line from which current may be obtained. The electric light will do much to ensure cleanliness; a temporary installation is not expensive, and it will also materially reduce the fire hazard. On a large piece of work of long duration where power machinery is used, it will pay to install a lighting plant, and especially where the electric current can also be put to other uses.

Where ordinary lamps must be used, they should be kept clean and in good order at all times, and their placing should be so safeguarded that they are not liable to be overturned when being lighted, or knocked over when men are passing back and forth. Bracket lamps fastened to the wall as high as possible and equipped with metal protectors may be used. In many places lanterns will furnish ample light and are safer.

Sufficient Ventilation Should Be Provided

All camp buildings should be provided with sufficient means for ventilation, even though built in the most temporary manner. This refers particularly to the sleeping quarters. Sufficient fresh air without unnecessary exposure to cold and storms will do much to keep the working condition. Should the dining-room become too hot and stuffy during meal-time the men will complain, and the matter can be easily remedied, but at night men are apt to sleep in poorly ventilated bunk houses without realizing why they do not feel rested and refreshed in the morning. It should be made the particular business of some one man in each bunk house to see that there is sufficient circulation of air before he retires. All windows should be in condition to open and close readily, and the roof should be provided with ventilators. Proper means of ventilation can be installed easily and inexpensively.

Outhouses

Outhouses sufficiently ample for the needs of the camp must be provided, be made as convenient as possible, and located at a safe distance (not less than 200 feet) from any camp building, where the natural drainage of the ground is away from the camp. The usual procedure is to dig one or more sumps, as may be deemed necessary, and erect suitable outbuildings over them. Such buildings should be kept as dark as possible by painting them some dark color and locating them in a group of trees, because flies shun dark places. They should also be screened. Keep them as clean as possible by sweeping them once a day and scrubbing them twice a week. Provide receptacles for paper. Cleanliness and neatness should not only be encouraged, but insisted upon. The excavation for a sump should be quite deep. Once a week the outbuildings should be moved to one side and a layer of chloride of lime and 6 inches of earth placed over the excrement. When the filling nears the surface of the ground the excavation should be entirely filled and a new sump dug in another location. Chemical or waterless toilets may be necessary in some localities.

It is a common experience that it is comparatively easy to get men to comply with rules for sanitation in camps established for long periods, but that they are careless in the small camps established for only a few weeks; therefore strict and definite rules must be laid down and their compliance insisted upon as part of the condition of employment. If the camp is fortunate enough to have a liberal supply of running water so that sanitary closets and a cesspool may be built, these should, by all means, be provided.

Reorganization of Toronto Building Specialties Concern

The Black Building Supply Company, Ltd., 201-2 Mail Building, Toronto, a well-known firm handling building specialties, has changed its name to Drummond & Reeves, Limited. Both Mr. N. W. Drummond and Mr. L. A. Reeves, of the new concern, were connected with the old company. Under the new arrangement the reorganization will carry on the business that has been developed by the Black Building Supply Company during its seven years' existence. It will be the aim of the Drummond & Reeves concern to do everything in its power to give first-class service to its old customers and at the same time develop a new clientele by handling a wide line of well-known building specialties. Among the building materials which are being handled are: Architectural terra cotta and face bricks, salt-glazed and enameled brick, paving bricks, the Toch Brothers' paints and waterproofing, plasterers' metal corner beads, picture moulds, bases, etc., and patent safety scaffolding machines.

British Road Board's Report Describes War Effects

HOW road construction and maintenance in Great Britain have been affected by war conditions is described in the seventh annual report of the British Road Board, which is pubilshed in the "Surveyor." From this report are extracted portions that indicate how war-time traffic has disrupted many miles of road and how lack of funds has deferred repair. Certain recommendations and suggestions for after-war reconstruction are also presented:

Heavy Motor Traffic Has Caused Damage

The heavy motor traffic directly or indirectly connected with military movements and the transit of warlike stores has caused a great deal of damage to many miles of road, and, notwithstanding the expenditure of nearly one and a half million pounds, which represents the cost of special work on public roads paid for out of army funds and other government contributions, an extensive road mileage, used by the special traffic referred to, has greatly deteriorated in condition. No doubt is entertained by the board that a considerable amount of expenditure will have to be incurred on these roads after the war. Many other roads have also suffered damage by the substitution of motor traffic for horse-drawn traffic in connection with agricultural operations in some counties. Concurrently with these things the expenditure of highway authorities on maintenance has been reduced, partly for financial reasons and partly owing to shortage of labor and materials. There will, therefore, be a considerable leeway to be made up after the war before roads can be restored to their pre-war condition.

Meanwhile the policy of the board in regard to making grants and loans has been continued on the lines laid down by the treasury. During the current year the board are distributing, with treasury sanction, a sum of £200,000 out of the Road Improvement Fund, mainly in the form of assistance to expenditure on tar treatment of main county roads in Great Britain which are in a suitable condition for tar treatment, and in doing so they are endeavoring to secure that sections of road which were improved with the aid of road board grants prior to the war shall be preserved, as far as possible, in a condition which will prevent the benefit of improvements already made being lost.

Apart from the question of deferred maintenance expenditure and special damage caused to roads by heavy motor traffic in connection with the war the question of expenditure required in the near future for the improvement of roads has been considered by the board, and their views on this matter are set forth in a letter addressed to the secretary of the Reconstruction Committee.

Classes of Reconstruction Work

In this communication the board state that the works of road construction and improvement which are required and, if funds were forthcoming, might be available for execution after the war, may be divided into four classes:

1. Works of (a) strengthening and resurfacing, and (b) drainage reconstruction, and resurfacing, which are of first importance, and should be proceeded with as soon as finance, labor, and materials can be provided.
2. Works of road widening and new construction which have been approved, but the execution of which was postponed owing to the war, on financial considerations.
3. Reconstruction of bridges on important roads which are unable to support heavy motor traffic, including bridges owned by railway and canal companies.
4. Schemes for the construction of new roads and bridges, widenings in urban areas involving the purchase of buildings, and widenings and improvements of important country roads involving the purchase of property. These schemes represent desirable improvements, but their value in relation to their cost can only be determined by investigation and consideration of each scheme by the local authorities concerned, in conjunction with the Road Board.

Urgency of Reconstruction

The most urgent need at the present time, the board continues, is the reconstruction of important roads which are too weak to carry modern traffic. The urgency of this reconstruction is twofold—(1) To provide for the traffic of heavy motor vehicles which is expected to expand rapidly after the conclusion of the war, and if not provided for in advance will cause serious deterioration of roads and consequential damage and expenditure; and (2) experience has shown that it is less costly to highway authorities, in the long run, to construct roads of a type suitable for the traffic, rather than to continue the use of methods and materials which have become antiquated.

The total mileage of roads in England and Wales is 152,000. It may be assumed that 10 per cent. of the total, or about 15,000 miles, stand in need, more or less urgent, of reconstruction or strengthening, as distinguished from resurfacing in the course of ordinary maintenance, in order to enable the roads to carry the growing motor traffic. The cost of reconstruction may be estimated at from £1,000 to £4,000 per mile, or at an average of £2,000 per mile. The total cost of dealing with 15,000 miles may be estimated, therefore, at approximately £30,000,000 over and above the normal expenditure of the local authorities on current and deferred maintenance.

Classification Under Way

It may be mentioned that shortly before the outbreak of war proposals were under consideration by the government for the classification of the roads and a revision of the exchequer grants to local authorities in respect of their expenditure on various semi-national services, including roads. The Road Board, at the request of the Local Government Board, had undertaken to classify the roads in England and Wales, as such classification was an essential preliminary not only to a sound scheme of state aid, but also to any general scheme of reconstruction. The classification was nearing completion on the outbreak of war, when the work was suspended. It will be practicable, however, to continue the work from the point at which it was broken off as soon as the board receive authority to proceed.

Widening and New Construction

Although, as a class, all such works as new roads, widenings, etc., are of secondary importance, as compared with the reconstruction of the road crusts of important roads, there are some which are of considerable value, and should be carried out side by side with road crust improvements. Applications in respect of such works have been received by the board, and a number have been approved by them as suitable for assistance from the Road Improvement Fund and as works which may be carried out as soon as circumstances permit, the total estimated cost in England and Wales being £1,314,152. It must be understood, however, that this includes only such works as have been made the subject of an application to the board.

There are similar works which would be deserving of assistance as soon as the urgent works of reconstruction are completed or funds are available. The cost of works in this class which may have to be taken in hand at some time or other would probably not be less than £5,000,000.

New Roads and Other Improvements

Suggestions have been put forward from time to time for schemes for the construction of new roads and various improvements, but the consideration of which has not been entered upon in detail in the absence of any prospect of financing them whilst the more urgent work of road-crust improvement was in progress. These schemes may be grouped into the following classes:

(a) New approach roads to large towns.
(b) New bridges giving additional communication.
(c) New roads to connect county boroughs.
(d) New by-pass roads to avoid narrow villages.
(e) Improved communications and widenings in urban areas, involving high cost, due to the purchase of buildings.
(f) Improvement and reconstruction of important through routes, involving the purchase of property and costly work.

These and similar schemes, the aggregate cost of which would amount to many millions, have not been examined or estimated in detail by the Road Board in conjunction with the local authorities, nor has the relative public value and cost been appraised, a work which would involve a large expenditure of time and money, for the reasons already mentioned. It may be assumed that, in almost every case, the local authorities affected would not be prepared to accept financial responsibility for schemes of the character under discussion, and that their contributions towards them, except in the case of some urban widenings of only local importance, would represent but a very small fraction of the cost. For this reason very few of such schemes can be regarded as being within the range of practical consideration at the present time, especially whilst the really urgent work of road-crust improvement remains to be undertaken when funds are available.

Special Work for Military Purposes

The board have continued the special work which they undertook after the outbreak of war at the request of the Army Council, namely: (1) To supervise and arrange for the construction and maintenance of new roads, and the improvement of certain private roads in several districts for military purposes in connection with camps and otherwise, and to carry out such work, where required, by direct labor; (2) to arrange with highway authorities for improvements on public roads, mainly at the cost of the Army Council, required for military purposes, and to supervise, or to carry out by direct labor, the execution of the improvements; (3) to settle by negotiation with highway authorities the amounts payable by the Army Council in respect of damage caused by extraordinary traffic in connection with military purposes. Similar work has, with treasury approval, been undertaken for the Admiralty, Ministry of Munitions, and Timber Supply Department of the Board of Trade.

Flexible Joint Pre-Cast Concrete Pipe

Laid Below Water in Lake Erie for Outfall Sewers—Cleveland Pipe Has Concrete Ball and Socket Ends

At both Lakewood, Ohio, and Cleveland there are now being laid outfall sewers, extending into Lake Erie, in which a new design of flexible joint has been applied to precast reinforced concrete pipe. In both places the pipe are cast on shore, floated out on barges, and sunk in previously made trenches. There they are set in place by a diver in sections so jointed as to permit movement due to foundation settlement. The Engineering News-Record describes this installation as follows:

The trench bottoms are situated in ground sufficiently solid to permit putting in the outfall pipe without the interposition of piles, but the irregular bottom made some flexibility of joint indispensable. For the earlier of the two jobs, that at Lakewood, alternative steel and concrete pipe-line designs were made; but the prohibitive cost of metal led the engineers to accept the bid on the concrete pipe, the novel details of which were worked out for this job by the Lock Joint Pipe Company, of Ampere, N.J. The Cleveland sewer was designed after the success of that at Lakewood was assured, and a concrete pipe line of somewhat similar but improved type, devised by the same company, was accepted without competition by steel or cast-iron pipe, the cost of which was then almost prohibitive. In this later design, however, even the metal spigots and bells of the Lakewood type were avoided, and the joint was made in concrete cast to the proper shape.

A 1,500 Foot Line

The first of the two lines is an outfall from the sewage disposal plant of Lakewood, a suburb of Cleveland. This line is 1,500 ft. long, connecting just inside the shore line, with a 36 in. reinforced-concrete sewer some 10 ft. below ground, and running in trench cut in the shale bottom of the lake to a maximum water depth of about 20 ft. The first 1,100 ft. of the pipe is 36 in. inside diameter, and the last 400 ft. decreases to 24 in. The end is provided with a flap valve, and the whole 400 ft. section has 4 in. perforated holes to disperse the effluent.

The pipe units are each 22 ft. 2 in. long, made up of three 4 ft. lengths of ordinary "Lock Joint" reinforced-concrete pipe, with the regular poured joint, and two end sections, one having a cast-iron bell and the other a cast-iron spigot. These castings are placed in the bottom of the form in making the pipe, and are tied in to the reinforcement of the shell. They also are provided with offsets reaching up into the concrete to ensure a tight connection between the concrete and the casting. Each bell and spigot casting has four lugs, through which 1 in. rods tie together the five pipes into one unit. Each casting has also two diametrically opposed lugs, through which short 1¼ in. bolts are passed after the pipe is lowered into the water to make a connection with the adjacent pipe. The bell and spigot castings have opposing spherical surfaces which come in contact with each other when the short tie bolts are drawn up, and form the joint which permits movement of the pipe around the tie-bolt diameter in case of any settlement in the foundations. The joint is made tight further by a ½ in. lead pipe gasket, which is sweated around the spigot casting in a groove provided for it.

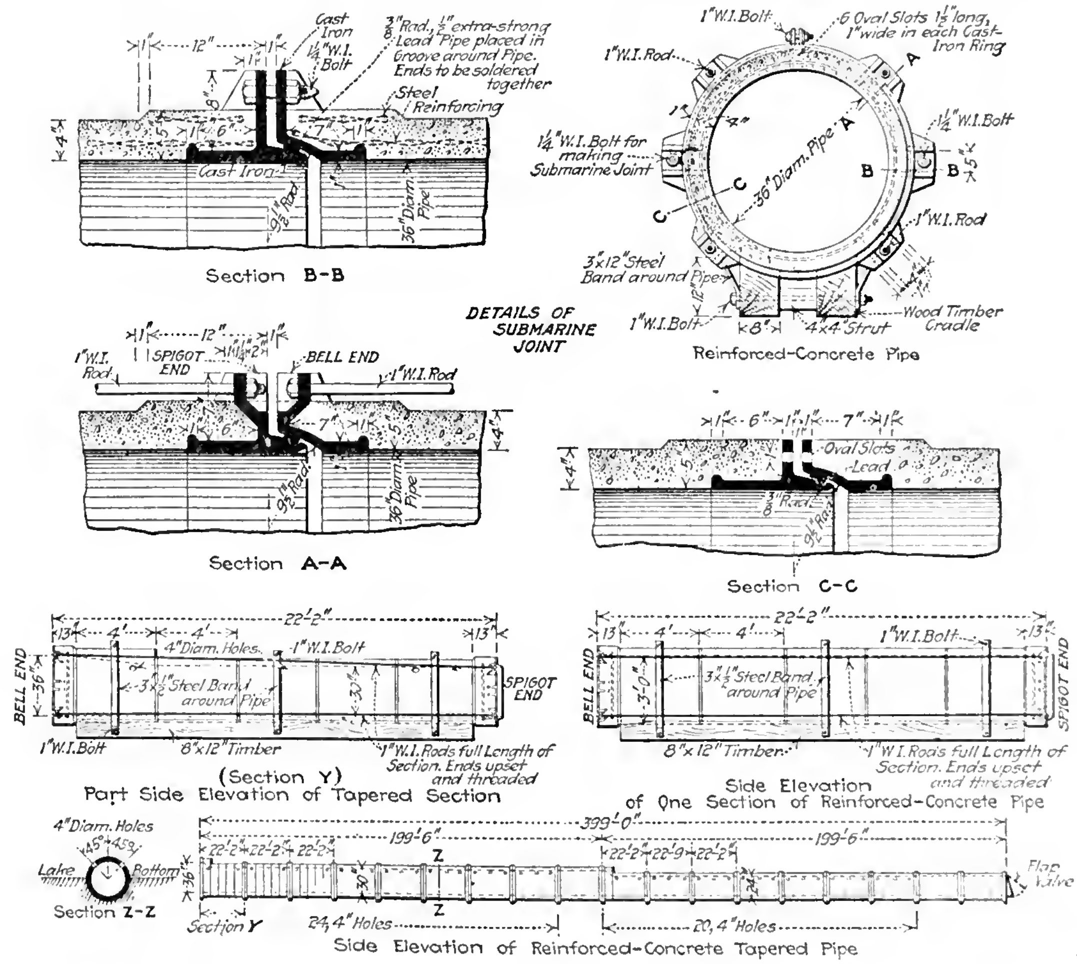
Manufacture of Pipe

The separate small pieces of pipe are all cast at a plant at the mouth of the Rocky River, just adjacent to the outfall site. The five separate pieces for each section are then assembled on a cradle of two 8 in. timbers, which are strutted and tied together at the proper spacing, and which have upper faces adzed off to the curve of the pipe. The joints in the intermediate pipes are then poured and wrought-iron bands bolted through the timbers are tightened around the tops of the pipes to hold them fast to the cradle. The longitudinal tie-rods are then inserted and brought to bearing, and the section is ready to be placed.

The 400 ft. tapered portion of the pipe is in two sections, the first 30 in. in diameter and the last 24 in. in diameter. The step is made at the initial pipe of each section, and all the remaining pipes in that section are standard 30 in. or 24 in. pipe, as may be required. Except for this change and for the 4 in. holes to let the sewage out, the details of the tapered section are the same as for the full section.

The work of setting the pipe was begun during the past summer and has progressed very favorably. They are loaded on a derrick barge and towed to place at the outfall, where they are lowered into place from the derrick, being suspended by a two-way line. A driver working below sets the bell and spigot together and brings the tie-bolts, which are in the horizontal axis of the pipe, to a tight bearing. Inspection of the pipe so set has shown that the lead pipes were squeezed practically tight by the action of the bolts. The 22 ft. lengths of concrete pipe are very rigid, and show no appreciable deflection when being hung from the two-way line. The diver is able to set from four to six pipes a day, working in 15 to 20 ft. of water.

The Lakewood outfall work is under the direction of E. A. Fisher, city engineer, and R. Winthrop Pratt, consulting engineer. The work is being done by the American Construction Company, of Cleveland, and the pipes were designed and cast by the Lock Joint Pipe Company, of Ampere, N.J.



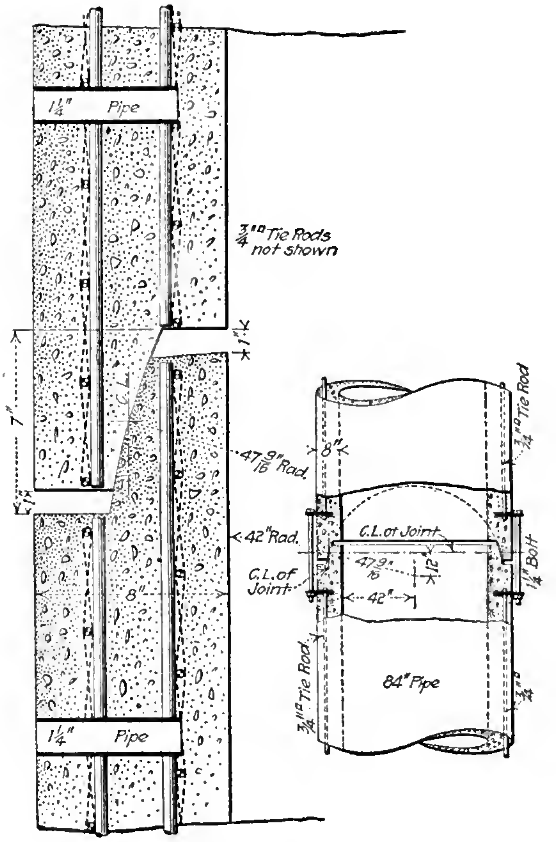
Flexible joint reinforced concrete pipe designed for outfall sewer into Lake Erie at Lakewood.

Cleveland Outlet Has Concrete Joints

The Cleveland outlet sewer is being built by the city at the foot of East One Hundred and Fortieth Street. Here the pipes are very much larger than at Lakewood, being 84 in. in diameter. On account of this large diameter it was felt that they could be cast safely for their full length in one operation, so the intermediate joints have been dispensed with. Each pipe is 20 ft. in length and is cast on end near the site.

It was also found in the Cleveland work, which has just been begun, that the cost of castings was so high as to require some other device for the bell and spigot joints. The one shown in one of the drawings herewith was adopted. In this it will be seen that the hemispherical contact surfaces of the Lakewood joint are obtained, but that they are of concrete. To make this joint it was necessary to have forms of cast-iron specially machined true to line and surface. These were placed in the bottom of the pipe forms and the concrete of the pipe shell poured upon them.

The tie between adjacent pipes is also somewhat different in the Cleveland pipe. A 1¼ in. iron pipe is



Outfall sewer at Cleveland has oncrete bell and spigot cast to hemispherical curve.

set in the shell of the concrete pipe to a depth of about 6 in. and about 8 in. from the end of the pipe. In these pipe threads are tapped and eye-bolts screwed in, and through the eyes of these latter bolts 1¼ in. tie bolts are passed. In order to take up the reaction of these tie-bolts, however, the vertical iron pipes carrying the eye-bolts are held together through the 20 ft. length of the pipe by one ¾ in. rod hooked around the pipe insert and embedded in the shell of the concrete pipe. It is intended to put a heavy asphalt paint on the hemispherical faces of the joints, so when they are brought to bearing there will be a certain amount of the asphalt squeezed out to form a tight joint.

This pipe line is 3,400 ft. long, 2,400 ft. of which is to be 84 in. diameter, and the last 1,000 ft. to be tapered down in the same manner as is the Lakewood pipe, to a minimum of 48 in. The pipes are now being cast, but none of them has been set.

The work is under the direction of Robert Hoffman, chief engineer of the city of Cleveland, the Lock-Joint Pipe Company being the designers and makers of the pipe.

Why Some Contractors Fail to Make Money

FROM time to time there is extended discussion of why contractors fail to make money. One sees discussions of the subject bearing on almost all phases of the matter, but rarely is there any question as to the competency of the men who hold the contracts. And, indeed, this is not a surprising thing, for contracting is an honorable and an honored business, and many who engage in it are among the leading men of the day.

On the other hand, many small undertakings, especially in the line of public works, fall into the hands of men who are not possessed of great experience, and who, no matter how well they intend to do, are nevertheless handicapped by this lack of experience. An example of this is cited by a writer in Engineering and Contracting, who has had occasion to visit small jobs and has had opportunity to observe the wonderfully low efficiency in handling men which many small jobs show, and it has often been a question in his mind as to whether the ordinary foreman knows how to find out even the most elemental facts as to how steadily his men are working.

One very good way to do this is to find a place where one can watch a force of men at work without being too closely observed and then count the idle men, the count being repeated every minute over a period of fifteen or twenty minutes and repeated two or three times a day. Thus on a job in Iowa the following record was recently made:

On the job: One foreman, one inspector, eight laborers, in sight. (There were two or three others on the job who could not be seen from the point where the counts were made.)

Count.	Men. idle.	Men at work.
2.31	4	4
2.32	4	4
2.33	6	2
2.34	3	5
2.35	8	0
2.36	5	3
2.37	6	2
2.38	4	4
2.39	3	5
2.40	2	6
2.41	5	3
2.42	7	1
2.43	7	1
2.44	4	4
2.45	6	2
	74	46

Average at work, 3+.
Average idle, 5.

The unescapable impression which this simple count gives is that more than half of the time of the men employed on this job was being lost. If to this one adds the time of the foreman, who in this case did nothing but "boss the job," the condition of affairs seems even worse.

There is nothing new or original in this simple count to determine the elementary question as to how much positively wasted time there is on a job, but if more contractors would adopt it there would be more of an effort to save labor by arrangements of the force which would eliminate the lost labor.

Two Men for One Man's Work

On the job in question a mixer was running at full speed during the whole period of the count. It had been running for some hours before the count was taken and ran on after the count was made. Three of the eight men fed sand and gravel to the mixer. The sand and gravel were not separate, but were mixed together, the aggregate being a run of pit material used without screening. One of these men was always idle. Two should have fed the mixer with ease, even though it seemed that the aggregate had been unloaded farther from the mixer than was necessary or advisable.

One man brought cement to the mixer. He was a dead expense, and idle over half of the time. The cement could just as well have been unloaded on a platform where the man who tended to the mixer could have gotten at it without assistance.

Another man pumped water for the mixer. A small power pump connected to the mixer engine should have handled this work. This man was idle two-thirds of the time.

The man to tend the mixer was needed, but the man who dumped the mix and shoved it down a trough set at a light slope when it should have been set steep enough to permit the concrete to run or, better still, when the mixer should, as in this case, have dumped direct into the forms, was a dead loss.

The man who tamped the concrete in the forms was needed, but he should have also tended to dumping the batches as they were mixed. Thus careful management would have cut this force of eight men to four men, and it is not asserting too much to say that none of the four would have been overworked.

Enquiry was made as to the financial side of this job. It had lost money. No wonder! Using two men to do one man's work is seldom profitable.

Belt Influence on Motor Drive*

A POINT very often underestimated when purchasing belts is the influence of the belt on motor output. Any one of the following conditions may affect the power an engine is capable of developing, and each one should receive due consideration from the purchaser when selecting his belt equipment: Belts too wide, too narrow, too heavy, too light, too tight, too loose, too hard, and too dry.

It is a recognized fact that many motors are accused of being inadequate for the purpose originally intended when the real cause of their incapacity to draw rated loads has been discovered in unfavorable belt conditions.

A cast in point is that of a new motor which was installed in a certain mill on the strength of its maker's claim that it would develop abundant power for all requirements.

The purchaser of this motor, contrary to the advice of its maker, refused to consider new belting as part of the necessary equipment. He thought an old elevator belt good enough on this new unit for what he failed to realize was very important work. There was the inevitable result. Sufficient power to operate the machinery under any load was not forthcoming. The belt, being too thick, heavy, hard, and unnecessarily wide, lacked the pliability essential to a belt driven rapidly over small pulleys.

Belt Was Faulty

The motor was blamed. Its manufacturer was requested to remove it or find a way to make good his guarantee. He chose the latter option, because he knew where the fault lay. His first and only move was to persuade his customer to secure a belt properly proportioned for the class of work in hand. Immediately it was installed sufficient power was available.

While it is good practice to use belts as wide as possible to ensure greatest contact on pulley surface, a belt wider than the pulley should in no case be used. On the other hand, it is not wise to employ belts too narrow, unless the machine they are driving does not require very much power.

Heavy belts are intended mainly for long drives over large pulleys, or for conveying or elevating purposes. They should never be used on small pulleys because they are not flexible enough to conform, without injury, to other than fairly large surfaces. Take a short piece of any belt, bend it, and you get the idea. If bent quickly and rapidly the compression of the contact side is unreasonably severe, and the stretch of the overside is brought next to the breaking-point. Then, agan, it is not possible for a heavy belt to give maximum power on the small pulley. The reason for this is that the arc of contact is less than it should be for a thick belt to take hold properly.

Light Belts for Small Pulleys

A wide, light belt on long drives would be totally inadequate, also, on account of its great flexibility making it incapable of pulling evenly without flapping or slipping when subjected to heavy draws. Light belts are of necessity made for small pulleys on high-speed machines, where compression and stretch must be reduced to the minimum and plilability assured so that the arc of contact is sufficient for the transmission of full power at lightning speed. Light belts on long centres will whip themselves to death.

Tight belts are responsible for much waste power. With them there is always a possibility of the pulleys and shafting being drawn out of alignment, which results in a consequent lessening of driving force through binding. And, besides, if the pulleys and shafting are so firmly placed that the tightness of the belt does not affect them, the belt undergoes undue strain, making inevitable the stretching, breaking, or giving of the spliced or laced joint.

Belts should not be too loose or slipping and running-off will be frequent and lack of driving force prominent. Rather than having them too tight or too loose, they should have just a visible sag on the top.

It is only natural that hard and dry belts will not drive properly nor transmit the required amount of power. While we do not advise the continuous application of belt dressing, the addition, in small quantities, of equal parts of red lead, black lead, French yellow, and litharge mixed with linseed oil and japan, will improve the driving surface and increase the durability of the belt, especially where excessive heat tends to dry out the rubber.

*Contributed by Dunlop Tire & Rubber Goods Co., Limited, Toronto.

The Dake Engine Company, Grand Haven, Mich., have issued Catalogue No. 27, illustrating and describing air and steam motors, pneumatic hoists, contractors' equipment, marine machinery, etc.

The County Highway Engineer—His Duties and Responsibilities

WITH the growing increase in the amount of highway work being performed by county organizations the county engineer has a position of increasing importance. An interesting discussion of the duties and responsibilities of the position was given by Dr. L. I. Hewes, district enginees of the United States Office of Public Roads and Rural Engineering, in a paper presented at the recent Western convention. An abstract of the paper follows:

In the past to a great extent county highway engineers have necessarily been transplanted railroad engineers, former city engineers, or graduated civil enginees with little specialization. It takes but a year or two of actual road work, however, to convince the most skeptical that highway engineering has a distinct place among other branches of engineering, and that it deserves the place it is rapidly winning.

There are rapidly opening up in the 3,000 counties engineering positions that require high professional skill, but the path of preparation leading to these positions is not entirely clear, and the duties of these positions remain to a large extent undefined.

Engineer Does Not Plan Work

Often when a community becomes conscious that a road is needed from point A to point B a situation arises which defeats the best efforts of the highway engineer. The public importunes the administrative authorities to consider the needed improvement. There follows discussion and newspaper comment until a decision to build the road is reached. A non-technical committee then decides how wide (and often how thick) the road shall be, and how much money it shall cost. Then the highway engineer is called upon to construct the highway.

If he has failed under such circumstances to produce a road of the quality, depth, width, and grade visualized by the enthusiastic community we should not blame him too severely.

This type of procedure is very common. The county highway engineer is not allowed to plan the work in the beginning. This inferior position to which he is relegated in the procedure has probably in the past misled many a young man to the idea that his duty was correspondingly easy, and could be assumed with little or no experience. But he has been rudely awakened to the realization that the community does not enquire into the conditions under which he works when failures result, but holds him responsible only for results.

If the position of county highway engineer is to attain any professional dignity among the engineering group it would seem that it must cease to be elective, and must command adequate salaries. It is believed that county officers would prefer to make appointments to the position of county highway engineer, and such a method would avoid much conflict.

Time to Work Out a Plan

Working in harmony with the county authorities well prepared, and with a high sense of professional standards and adequately paid, the county engineer may hope to achieve a first essential in planning of his work, and that is to secure enough confidence on the part of his superiors and of the community to allow him to expect a term of office extending over a period of years. It is idle to discuss planning of highway work unless sufficient time is presupposed to work out a plan. The public is learning, by repeated failure, that road reform does require time. If the county highway engineer can be insured of a reasonable tenure of office his work will be done with greater economy in the end. The difficulty with highway work is not an inherent technical difficulty, but a political difficulty causing constant interference with the technique.

It will doubtless be granted that the first technical duty of the county highway engineer is to study his county and to make a careful record of what he finds. This record should include a map on which the highways may be classified in two ways—first, with respect to their service to the community as through roads, market roads, or neighborhood or community roads; second, with respect to their type of relative improvement. Supplementing such maps there should be carefuly plotted the location of all available road material as fast as discovered, with sufficient attached data to show where such material was used, when, and with what results, and the approximate cost. In addition to such field information, it is necessary for the county highway engineer to know thoroughly the financial history of the county and particularly the past expenditures for highways, the possibility of their increase, the indebtedness of the county, the relative amount used for schools, and other purposes. With this knowledge as a basis, the county highway engineer should make it his duty to institute modern cost bookkeeping methods in all the work he does. Such cost-keeping methods are summed up by the ideas of distribution of costs and development of unit costs. The reason for cost keeping is twofold—to prevent waste and inefficiency, and to enable intelligent planning of new work.

The program for county highway work will be conditioned by the results of the field investigation and the financial history, and the effectiveness of the highway engineer will be measured by the skill with which he can develop efficiency under these limitations in a plan of road improvement for the county.

It is manifest that he must improve by new work certain miles of road each year; that he must maintain such new work with especial faithfulness, and that he must also repair additional miles of road and maintain those repaired miles; and, furthermore, maintain in a passable, good condition the residue of the road mileage of the county. The equipment necessary for such work must be found and the distribution of expenditures must be planned.

Keep to Well-Tried Methods

It is a mistake for county highway engineers to take the attitude that conditions in their counties are "special conditions"; that they have peculiar drainage, or subsoil, or road material; and that, therefore, certain practices are permissible in that county that are manifestly against standard procedure. While it is admitted that the construction and upkeep of roads offer an endless variety of operating methods, nevertheless well-tried principles underlie all such practice, and only such principles will ensure good results. For example, it is known absolutely that trap rock cannot be bound with clay with economic results; that a boggy spot on a side hill cannot be cured by placing material on top of it.

It may be that the entire highway engineering profession would be benefited by resignations when professional methods of the engineer are questioned or set aside. That many highway engineers continue in office doing work against their best judgment is unfortunate. Perhaps it is evidence that the engineers cannot back up their judgment either with sufficient experience or with forceful English.

It seems to be true that the domain of highway work presents so many varied problems that chance for individual judgment is very great. It is correspondingly desirable, therefore, that highway engineers be absolutely informed as to the underlying or invariable principles that must obtain everywhere. The public must be taken into the engineer's confidence; the sympathetic co-operation of the newspaper is desirable; and it must be frequently understood that the engineer is proceeding under financial limitations over which he has little control. He must postpone the construction of much-needed improvement while he brings to a passable standard many miles of road that must be traveled every winter. If he can plan for a series of years, it will be possible to survey the roads and establish their profile and work gradually toward the new plan and the new profile without loss. Culverts can be installed to correct grade and length if the complete profile and plan are available. Maintenance operations can be undertaken with full knowledge of what is to follow with the next succeeding year. The purchase of road machinery may be planned economically. The installation of crushing plants may be made with a view to their use beyond a single season. The purchase of culvert pipe may be made in a quantity and the general business of roads in the county handled on a permanent basis.

Effect of Storage on Coal

THE need of a thorough understanding of the conditions affecting the storage of bituminous coal is becoming more or less apparent. The demand for coal at certain seasons is so great that both mining and transportation facilities are taxed severely in meeting it. Provision has not been made for adequate and proper storage of bituminous coal either at the mines or at the distributing centre; and as a result of this lack there must be maintained throughout the year a sufficient number of operating mines to meet what may be termed the "peak load," which occurs during the winter months. At such times also there is often a shortage of cars, although a smaller number of cars even than is now available would be needed if the work of transportation could be more evenly distributed throughout the year. These wastes eventually affect the cost per ton of coal which everyone must pay as a contribution toward the capital investments.

The effect of storage upon the properties of coal is treated in a publication known as Bulletin No. 97, of the University of Illinois Engineering Experiment Station. The work therein recorded is a result of long-time studies upon samples of coal stored under various conditions.

From the facts presented in this bulletin the following conclusions are justified:—

(1) Bituminous coal can be stocked without appreciable loss of heat values provided the temperature is not allowed to rise above 180 degs. F.

(2) The indicated heat loss per pound of coal is due more largely to an increase in weight of a unit mass of coal resulting from the absorption of oxygen than to an actual deterioration or loss of heat units.

(3) Freshly mined coal has a large capacity for absorbing oxygen which combines chemically with certain constituents at ordinary temperatures.

(4) The combination of oxygen with coal at ordinary temperatures generates a small increment of heat.

(5) The rapidity with which oxygen is absorbed depends upon the temperature of the mass and the fineness of division of the coal.

(6) If heat is generated by this slow process of oxidation more rapidly than it is lost by radiation, a rise in temperature is caused which quickly brings the mass up to the danger point of 180 degs. F. At this temperature practically all of the free moisture is evaporated and the further rise in the temperature will be very rapid.

(7) Any method of storage to be successful must either check or prevent the absorption of oxygen to such an extent that the generation of heat shall not proceed so rapidly as to exceed natural heat losses due to radiation.

Underwater Storage Prevents Slacking

(8) Underwater storage prevents a loss of heat values and is not accompanied by deterioration in physical properties, such as slacking.

(9) Dry storage is far more safely undertaken if the coal is screened out at the storage yard and the lump only is stored.

(10) There is an increase of "fines" or slack resulting from storage, greater with some coals than with others. This, together with the saturation of the free burning constituent with oxygen slows up the fire and gives the appearance of being lacking in heat value. However, with an increase of draft and a correct understanding of the combustion conditions to be maintained, a most excellent over-all efficiency can be secured even from coals which have been in storage for long periods.

The most serious part of the storage problem relates to the matter of spontaneous heating and probably the least serious phase relates to deterioration and actual loss of heat values.

Weathered Coal Gives Good Results

The following is a summary of experiments covering the behaviour of coal in steam generation after many years of storage:—

1. Burning weathered coal is largely a question of correct handling and ignition. Under these circumstances it gives as good results as fresh screenings.

2. Weathered coal requires a little thinner fire and more draft than fresh screenings.

3. When using weathered coal the fuel bed should not approach any nearer to the water-back than from 4 to 6 inches, otherwise trouble with clinker is experienced.

4. Practically as high capacity was obtained with weathered coal as with the other coals used, and, if anything, the fuel bed requires less attention.

Saskatchewan Engineers Consider Professional Status and Research Program

THE regular November meeting of the Saskatchewan branch of the Canadian Society of Civil Engineers was held recently at the Assiniboia Club in conjunction with the monthly dinner. The report of the committee appointed some time ago to present a resolution to Premier Martin relative to the standing of the profession in the province was received, and indicates that the Premier will place before the executive council the petition of the engineers of the province.

A committee was formed to get into touch with the other branches of the Society in regard to the proposed meeting of all members of the profession in some Saskatchewan city next summer. The committee is composed of L. H. Thornton, H. S. Carpentèr, J. N. DeStein, W. H. Greene, Moose Jaw, and Professor A. R. Craig, of Saskatoon.

The question of a research program to be dealt with by a number of sub-committees of the local branch was brought up. This contains two matters of vital importance not only to the profession, but also to the community at large. These are power and good roads. It was decided to devote the coming season to a thorough study of these subjects which will necessitate the co-operation of several public bodies and involve every member of the Saskatchewan Branch.

A paper by W. H. Greene, assistant city engineer of Moose Jaw, on sewage disposal, concluded the meeting.

Alberta and British Columbia Connected by Mountain Road

Important road-construction work in British Columbia recently included the connecting of the provinces of Alberta and British Columbia over the route to the south of Crows Nest Lake which was officially opened recently, thereby abandoning the old road over the summit at Crows Nest Pass. By easy grades the new road passes over the summit of the Canadian Rockies on the boundary line between Alberta and British Columbia, presenting to the tourist a scenery that is extremely beautiful.

Much has been done toward promoting public sentiment for road construction, and there are now a number of projects, proposed and under actual construction, throughout the Kootenay district in British Columbia. The Ymir Road to the south from Nelson, connecting the latter with Ymir and Trail, is nearing completion and will in all probability be ready for traffic this fall.

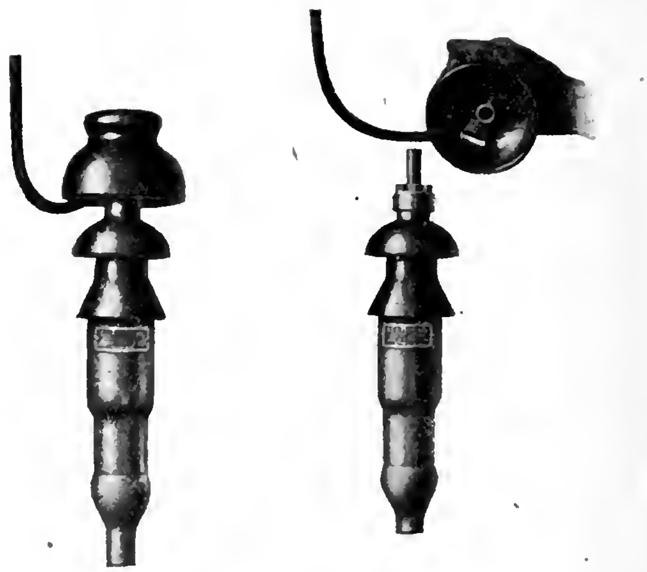
Another project that is ripe for realization is a wagon road from Sandon west to New Denver, and between Silverton and Slocan City to the south, establishing road connections with Nelson, Rossland, and Trail, and the whole Slocan district.

Up-to-date Water System at New Toronto Nearing Completion

Construction work on the extensions to the waterworks at New Toronto, Ont., is now nearly completed. This work has included the installation of a pair of mechanical pressure filters; four 1,000 gallon electrical centrifugal pumps and one 1,000 gallon gasoline-driven fire pump; an extension to the pump house; subsidence well; screen chamber; Venturi meter; overhead crane; hot water heating system and some 7,200 feet of water main. Considerable of the above work is for the Goodyear Tire & Rubber Company's sole use. When completed, New Toronto will have one of the most up-to-date waterworks systems in Ontario. The following were the contractors engaged:—R. C. Huffman, general contractor; American Water Softener Company, filters; Canadian Allis-Chalmers, Bawden Pump Company, and Epping Carpenter Company, pumps; Allen General Supplies Company, Venturi meter; Herbert Morris Crane Company, crane; J. H. Doughty, heating contractor; National Iron Works, pipe, and Bawden Machine Company, special pipe castings. James, Loudon & Hertzberg, Ltd., are the engineers.

A New Style of Cable Terminal

A new style of outdoor (Type D.O.A.) cable terminal has recently been placed on the market by the Standard Underground Cable Company of Canada. It is known as the protected disconnection style. All the copper parts are covered by a porcelain hood, as shown in the illustration, which permits the disconnection of the aerial extension wire even while the circuit is alive. All the outdoor (Type D.O.A.) cable



terminals made by the Standard company are readily disconnected from the aerial conductor either by means of a set-screw, cap-nut or turnbuckle stem. The stem of the new terminal is a modification of the regular cap-nut stem and has some additional advantages where frequent disconnection of the aerial circuit from the terminal is necessary. The new terminal, as well as the complete line of Standard outdoor cable terminals, is fully described in bulletin No. 700-2.

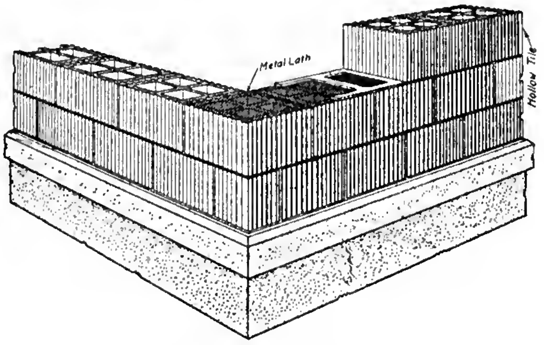
Nearly 1,000,000 horse-power of hydro-electric energy is utilized in Europe in the production of nitrogen—the mightiest weapon in both war and peace. Canada has many millions of horse-power running to waste, but none is used in the production of nitrogen.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Metal Lath Between Courses of Hollow Tile Prevents Waste of Mortar

LEADING tile manufacturers and the Associated Metal Lath Manufacturers are recommending the employment of expanded metal lath for a new purpose. This is in connection with the construction of hollow tile walls. In laying up the ordinary building wall of this type, when the tiles



To prevent waste of mortar and to guard against settlement cracks, metal lath is inserted between tiles

are set with the cells vertical there always has been considerable waste of mortar which would drop into the tile. To prevent this and to guard against settlement cracks, strips of expanded metal lath are laid between layers of tile before applying the mortar. The illustration herewith shows the idea of the scheme.

Wood Trusses Incased in Concrete to Resist Acid Fumes and Fire

CASING timber roof trusses in cement to protect them against fire and acid fumes is a novel method employed recently in the buildings of a large oil refinery in Texas. Wood construction was adopted on account of the shortage of structural steel. After the trusses had been erected, each member was wrapped with a single layer of light waterproof building paper, placed close against the surface and fastened with carpet tacks. The object of this covering is to prevent any bond between the concrete and the wood and to protect the latter from the moisture used in applying the concrete casing.

Sheets of expanded metal with ½-inch diamond mesh were then cut and shaped to fit the members and fastened by No. 12 nails and special chairs stamped from flat-steel strips. These chairs kept the expanded metal ⅝ inch from the surface so that it would be embedded completely in the concrete.

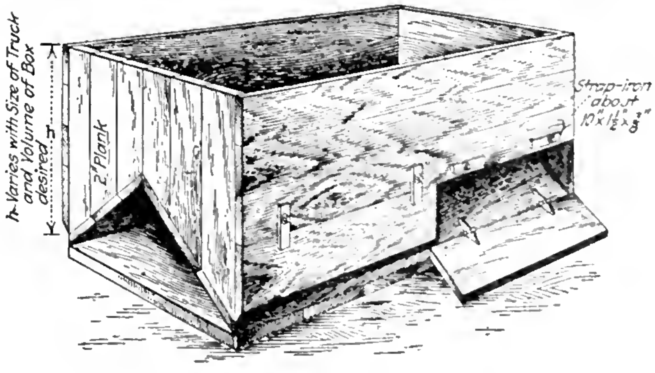
Guide strips were tacked along the edges of the members to obtain the proper thickness of casing and to act as striking boards for the corner lines. With the work thus prepared, a 1½-inch coating of cement mortar or "guncrete" was applied with cement guns. These operated under an air pressure of 35 lbs., supplied by two oil-driven compressors, each having a capacity of 250 cubic feet per minute. Before this coating had fully set, the guide strips were removed, and the surfaces left with an even finish.

The roof covering consists of a 1½-inch monolithic slab, built in place. Over the trusses and purlins was stretched a sheet of wire-mesh reinforcing secured by nails and chairs as noted above. Light wood panels were then laid upon this and the concrete for the underside of the roof slab was shot in place by the cement gun. After about 24 hours the wood panels were removed.

The concrete surface was then cleaned with compressed air and water to secure good bonding for the top coating, which was placed in the same way. Finally a thin coating of hot asphalt paint was applied. This work was done by the Cement-Gun Construction Company, of Chicago.

Removable Hopper-Bottom Truck Bodies Used for Rapid Unloading

CONTRACTORS who contemplate the use of removable hopper-bottom truck bodies, to secure rapid unloading of loose materials and ability to employ the truck on various services, will be interested in the side-dump boxes adopted by Wing and Munger, contractors for resurfacing Part 2 of New York State Road 387. The accompany-



Hinged side door throws material clear of the wheels

ing sketch of the arrangement is from Engineering News-Record.

One of the good points of this box is the bottom-hinged side door which falls down as soon as the catch button is released, and serves as an apron to throw the material clear to the wheels. Each side has a divided door, so that quadruple control of the dumping is secured. The box ends are solid and with the inverted V-bottom make possible a rigid unit that can be easily put on and taken off the truck.

Opposes Revision of Specifications for Asphalt Paving so as to Differentiate Between Native and Oil Asphalts

Editor, Contract Record:

A copy of a circular letter, addressed to Mr. Frank P. Smith, chairman of the Sub-Committee on Asphalt Paving of the American Society of Municipal Improvements, by Mr. C. N. Forrest, chief chemist of the Barber Asphalt Paving Company, under date of September 25th, 1917, has recently been forwarded to members of the American Society. This letter makes the proposal that the Society so amend its standard specifications for asphalt paving as to differentiate between the native asphalts and the oil asphalts. To this proposal we are most emphatically opposed, and our objections are stated below.

Mr. Forrest advances several reasons for urging the amendments that he proposes; and these we may take up separately as follows:

First: "To differentiate sharply between the two kinds of asphalt available for sheet asphalt, viz.: Native asphalts and oil asphalts."

Reply: We do not know of any difference or differences between the hard crudes or native asphalts and the soft crudes or oil asphalts, of sufficient interest to the paving industry from the viewpoint of quality in the resulting asphalt cements, to make it either necessary or desirable to divide asphalt pavements into two classes along this line. The native asphalts must be manufactured into paving cements by refining and fluxing, while the oil asphalts may be so manufactured by refining only. No reason has yet been advanced that convinces us that a pavement properly laid of one class of material will last longer or give better service than a pavement properly made from material of the other class.

Second: "To identify, for purposes of record, the kind of asphalt entering into any specific piece of pavement."

Reply: Materials may be identified, for the purpose of record, in other and more desirable ways. The contractor should be required to furnish the asphalt cement manufacturer's certificate of materials and methods; and the city should reserve to itself the right to inspect both the manufacturing plant and its manufacturing records. The sample submitted at the time of bidding, or directly after, should be carefully tested; and all shipments checked against such tests. Careful municipal records, showing gradings of aggregate, bitumen content, temperatures, and so forth, should be kept. These things will make a real record; while the specifying of a given type of asphalt will not even prove that the type specified was used in the pavement. A specification is not a record of work executed, but of work proposed to be done. It establishes promises; not accomplishments.

Third: "To permit municipalities to select the kind of asphalt which, in the judgment of their officials, is best suited for the type of improvement under consideration."

Reply: Standard specifications, we believe, are an attempt to get away from the conditions where the officials of each city had to select the kinds of asphalt that, in their judgment, were best suited for the type of improvement under consideration. Most such officials have no proper facts upon which to base such a judgment, and we know only too well how often such judgments are even now based upon improper facts. The differentiating specifications suggested would make the course of the latter judgments easier to travel by seeming to have the justification of the American Society; where, at present, the official adopting preferential or monopoly creating specifications has his own explaining to do.

Fourth: "To prevent condemnation of asphalt pavements as a type because of the failure of an unrecorded kind of asphalt to function satisfactorily."

Reply: As a real record of the asphalt used in a given pavement can be easily kept otherwise, as a specification is not a real record of what actually went into a pavement, and as pavements improperly laid with both types of asphaltic material have already scored discreditable failures in some instances, we see no merit in the fourth reason advanced for the adoption of specifications differentiating pavements to be made with native and with oil asphalts.

Fifth: "To meet the existing demand of many municipalities preferring specifications which differentiate between native and oil asphalts."

Reply: We do not know of any legitimate demand now being made for specifications differentiating native from oil asphalts. Except for clever promotion work, probably no such demand would exist at all. If some of those city officials now clamoring for differentiating specifications would consult an independent asphalt paving chemist and engineer, instead of dependent salesmen, to find out what is wrong with their pavements, the cities for which they work would probably receive some material benefit, both in the quality and the economy of future work.

Mr. Forrest: "It is well known that there are several essential points of difference between the native and oil asphalts which can not be covered in a blanket specification for both kinds." Well, we do not know several such points that are essential to a degree that would justify the Society in adopting specifications differentiating asphalts along the lines suggested, and we presume there are others quite as ill-informed as ourselves. Therefore, we would request that Mr. Forrest state in detail the points he has in mind and the reasons why they are essential in the degree claimed. Coming from Mr. Forrest, we shall at least be certain our time will not be wasted in arguments that are merely selling talk; the Society is entitled to something more.

Specifications of the blanket type are always unsatisfactory at the best, but why differentiate along the lines of native and oil asphalts? Also, would a blanket specification covering either all the native asphalts or all the oil asphalts be any more satisfactory? It would be more logical, considering the public's point of view, to draw a specification for each one of each type of the asphalts, though, at present, this does not seem desirable.

Milton Hersey Company, Limited.
C. A. Mullen,
Director of Paving Department.

Mr. C. H. Bromley, who for the past four years has been in charge of the water and public works department of Grimsby, Ont., has been elected a member of the Institute of Municipal Engineers of Great Britain.

Church Contract Awarded

The contract for the construction of the church and presbytery of St. Pascal Baylon, Cote des Neiges, Montreal, designed by Mr. G. A. Monette, Montreal, has been let to Mr. L. J. Fauteux, St. Benoit, P.Q. The church is to be on a site 161 x 81 feet, and will be built on concrete foundations, with a steel frame, brick walls, and terra cotta fireproofing. The interior will be extensively decorated in the Byzantine style. The roof is to be of asbestos material. The church will have a seating capacity for 1,000 people. A hall in the basement will be 81 x 60 feet. The presbytery, which will adjoin, will be built on the same lines, as far as the material is concerned, as the church. The steel will be supplied by the Phoenix Bridge & Iron Works, Ltd., Montreal, while the plumbing, heating and roofing has been let to T. Latourelle & Son, Montreal.

Montreal Firm May Build Concrete Vessels

The John S. Metcalf Company, Ltd., Montreal, have under consideration the building of concrete vessels. Mr. H. Rolph, the president, has gathered a large amount of data from the United States and Europe, and has also been in conference, in New York, with the principal of a Norwegian firm specializing in this department. If it is decided to go ahead with the building of vessels, Mr. Rolph will visit the Maritime Provinces with a view to obtain shipbuilding sites. The idea is to build the hulls and not to manufacture the necessary equipment. The Atlas Construction Company, Montreal, have an experimental concrete ship under construction.

At the beginning of this year there were twenty blast furnaces in Canada, fourteen of which had been in operation for various periods of time during 1916. The total daily capacity of the twenty furnaces was about 5,135 tons.

Personals

Mr. George S. Newill, who has been on the staff of Laurie & Lamb as engineer, has accepted a position with the Dominion Bridge Company, Lachine, P.Q.

Mr. W. Clement Munn, of the contracting firm of Munn & Shea, Montreal, has been selected as Liberal candidate for the Montreal division of St. Lawrence-St. George.

Mr. J. J. W. Campbell has applied for the position of city engineer of St. John, N.B. This office was recently left vacant through the death of Mr. William Murdoch.

Mr. H. J. Fuller, president of the Canadian Fairbanks-Morse Company, has been appointed to represent the Imperial Munitions Board in New York in connection with munitions and marine equipment contracts.

Captain A. J. Latornell, formerly city engineer of Edmonton, Alta., is reported wounded in action. Captain Latornell is a graduate of the Faculty of Applied Science and Engineering of Toronto University, and his home is at Meaford, Ont. He went overseas as a lieutenant in a battery from Cobourg, Ont.

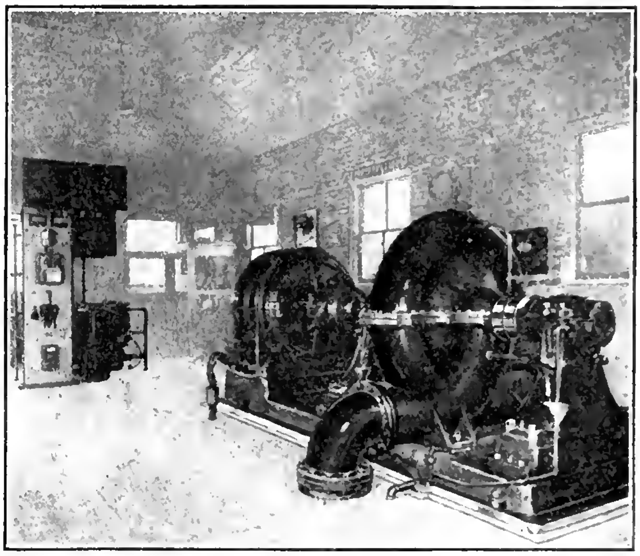
Mr. G. R. MacLeod, head of the sewers department of the city of Montreal, has joined the Imperial Munitions Board, having accepted a position in their organization now being established at Washington, D.C. The city of Montreal has given him an indefinite leave of absence. Mr. MacLeod was also the tramways expert of the city.

Toronto Pumping Plant Has Equipment Designed for Flexibility

The motor-driven centrifugal pumping plant recently completed at the Riverdale station of the corporation of Toronto is of interest to municipal and other engineers, owing to the great flexibility of speed and capacity of the unit. It was designed to deliver 5,000,000 imperial gallons in 24 hours against a head of 170 feet, and running at a speed of 720 r.p.m., but owing to probable variation in pressure and capacity the city required the unit to deliver either 3,000,000 gallons or 1,000,000 gallons against a lower head varying from 130 ft. down to 70 ft.

Single Stage Pump With Variable Speed Motor

Under such conditions it is usual to build a multi-stage pump, but the contractors, Canadian Allis-Chalmers, designed and built a single-stage pump which has fulfilled all the guarantees required by the city. The usual practice also is to supply constant speed induction motors for centrifugal pumps, but as the speed to fill the above requirements must



Unit at Riverdale pumping station.

vary from 720 r.p.m. down to 50 r.p.m., the Canadian General Electric Company built a special 250 h.p. variable speed motor, which also fulfils all the requirements of the city.

This pump is single-stage, split casing, specially designed and constructed to obtain the highest efficiency. It consists of a cast-iron spiral casing with discharge and suction inlet cast on to the lower body. The casing is split on a horizontal centre line, so as to facilitate inspection without dismantling pipe or any other part of the unit.

A set of removable diffusion guide vanes has been provided so as to guide the water from the impeller to the casing in the most efficient manner. The impeller is made of cast bronze, and is polished so as to eliminate unnecessary friction.

Special neck rings have been provided, so as to decrease the leakage water from the pressure side to the suction side. The impeller is of double suction type and the head of 170 ft. is generated in a single stage.

Proper stuffing boxes are arranged on each side of the extending shaft, and bronze sleeves are provided so as to eliminate rust and undue wearing. The shaft itself is made of the best hammered steel and of ample design to prevent any vibration.

Outboard Bearings for Shaft

Separate outboard pedestal bearings are provided in order to carry the shaft, and one of these bearings is arranged with forged collars, which act as a thrust bearing in order to take care of any unbalanced thrust which might occur occasionally. All bearings are arranged for water cooling, and are of the self-aligning ring oiling type.

Separate sub-bases are provided to facilitate dismantling and direction. Both bearings are tied up to the main pump casing by means of stay bolts, so as to make the whole unit as rigid as possible.

A flexible pin type coupling is arranged for connecting up this pump with the motor. The whole unit is set upon a heavy cast-iron base plate, which is grouted in to the foundation.

The unit has proven to be exceedingly quiet during operation, a point insisted upon in the specification, and to be well over 70 per cent. in efficiency at various tests, and operating under various conditions, which is notable for a single-stage type pump of such comparatively slow speed.

Mainly Constructional

East and West—From Coast to Coast

Fred Holmes & Sons, Ltd., Toronto, are retiring from business and are auctioning their builders' plant.

A by-law was recently passed by the Council of Mimico, Ont., providing that a public utilities commission be chosen by the ratepayers at the coming elections..

The ratepayers of Leamington, Ont., by a big majority, carried the by-law to raise $4,500 to secure the acreage of sugar beets necessary for an $800,000 sugar factory, in which Mr. Bricker, of Detroit, is interested.

A large staff of workmen are now engaged in the construction of an addition to the plant of the Pratt & Whitney Company, on Hatt Street, Dundas, Ont. The work will be probably completed before the spring.

The Military Hospitals Commission has awarded the contract for the erection of a military hospital on the Odell farm, near London, Ont., to John Hayman & Sons. The cost is approximately $100,000. Additions will be made later.

A new garage building has recently been completed in Collingwood, Ont., for Messrs. Bull Brothers. It is a one-storey structure, of reinforced concrete construction, and has a frontage of 44 feet by a depth of 155 feet. Mr. P. Palin was the architect.

Greater school accommodation is badly needed in the east end of the city of Hamilton, Ont. The Board of Education is considering the selection of a suitable site for a new building. It is suggested that a school of not less than thirty rooms be provided.

During the present year the expenditure for construction work on the roads of York County, Ont., has been $139,684. Of this amount the city of Toronto pays $41,905, or 30 per cent. The maintenance cost for the same period has been $19,611, of which Toronto pays $7,845.

The city of Belleville has made a grant of 25 acres to the Albert College on the condition that buildings costing at least $200,000 be erected on this site. The executive board of the college have agreed to spend this amount and to begin operations immediately at the close of the war.

The building permits issued in Toronto during the month of October were the largest for any month this year, with the exception of August. The amount is $786,225, an increase of $290,077 over the same month last year. For the ten months of the year the total is $10,752,603, an increase of $3,755,548.

A meeting was recently held in the Town Hall at Minden, Ont., with reference to the building of a hydro-electric railway from Kinmount Junction to Minden. After some discussion it was decided that a committee be appointed to take any steps considered advisable towards urging the Hydro authorities to carry out the project.

Four hundred feet of large storm drains have been completed on Gilkinson Street, Brantford, Ont., under the direction of Superintendent William Sutch of the Sewers Department. Work will immediately be commenced on Oxford Street, to complete the work as far as the Burford Road and the factory of the Canada Steel Company.

Arrangements have been made for the establishment of a new industry in the Toronto harbor district by the Dominion Shipbuilding Company. The site leased to the company is on the water-front, between Spadina Avenue and the old Queen's Wharf, and comprises 15½ acres. Buildings, slips, and drydocks will be constructed, and the firm will employ about 2,500 men.

General Logie, G.O.C. Military District No. 2, appeared recently before the Civic Parks Committee of Toronto to request that the city grant the use of 25 acres of land in High Park as a site for a hospital for returned soldiers. The hospital would have a capacity of 1,000 beds, and would be used exclusively for surgical cases. The committee sent a recommendation to the council that the request be granted.

In the good roads scheme recently adopted by the County of Renfrew, Ont., the Townships of McNab, Horton, Ross, Admaston, Bromley, Westmeath, Stafford, Wilberforce, Alice and Fraser, and Pembroke are included. When the roads designated have been improved, a system of permanent highways will have been established throughout the whole central portion of the county.

Through the courtesy of the Canadian Leonard Construction Company, the members of the Peterboro Engineers' Association were recently afforded the opportunity of looking over the plant of the Quaker Oats Company, now in course of construction. A party of about forty were present, including members and their friends, and after the inspection trip they adjourned to the Empress Hotel for dinner.

At a recent meeting of the Board of Control of Hamilton, Ont., the question of a municipal piggery was brought up, and it was pointed out that 2,000 tons of wet garbage, which could be utilized as hog feed, is thrown on the city dumps every year. It was, therefore, decided to take steps with a view to establishing a local piggery, and an appropriation was made for this purpose.

Exportation from Canada of iron and steel in unfinished or semi-finished forms, suitable for use in manufactures, will be prohibited by the government, except under license from the Department of Customs. The classes of iron and steel goods upon the sale of which outside the Dominion an embargo is placed, include pigs of iron, steel ingots, billets, rods, shapes, angles, and plates. This step has been brought about owing to the serious shortage of iron and steel for munition making, shipbuilding, and other manufactures.

The Toronto Harbor Commission are making favorable progress on the reclamation work at Sunnyside, and it is expected to have the filling in completed by about December 10. The hydraulic dredge, which has a capacity of between 10,000 and 20,000 cubic yards per day, started work about the middle of October. The dyke is practically finished, and the filling in will be continued until the present level is raised between five and seven feet, or within two feet of the dyke of earth. This will make the new boulevard considerably higher than the present roadway. The plans provide that the present Lake Shore road will be raised seventeen feet, and will be used as the radial line allowance, while the new road will be surveyed on the reclaimed area.

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Principal Contents

The Layman and Road Building

THE efforts of municipal councils to solve their road-making problems without the aid of competent road-makers appear pitiable and heartbreaking in the eyes of the man who knows how—all the more so in that it is an uncalled-for waste of energy and money. It is probably in the carrying out of road work, of all engineering undertakings, that the greatest follies—or might they better be described as crimes?—are perpetrated, because this branch of engineering is quite generally considered by the uninitiated layman as a matter of simplicity. All that is necessary is a gang of laborers, a boss, a road roller, a quantity of stone, and, if funds are plentiful, perhaps some road oil or similar treatment; and, with these, under the direction of the council, an adequate system of roads will gradually be evolved. Such is the opinion of many aldermen, until they find their community involved in financial difficulties and its traffic hampered by ill-planned and badly-surfaced roads.

Conditions such as these are, perhaps, more general than might be imagined—though, thanks to the active propaganda of our government authorities, less frequently met with than formerly. One case which might be cited is that of an Ontario town where the council were recently endeavoring to devise means of repairing sections of their streets, which apparently are in a very undesirable condition. One portion is described as a "wet, slippery, slimy mudhole in wet weather." In order to remedy this state of affairs it was first suggested that three-quarter inch stone be laid on top of the clay. However, the folly of this was evident, and the proposal was not put into effect. The next suggestion was to place large flags—which could be obtained in considerable quantity in the vicinity—over the surface, cover this with coarse crushed stone, and finish with three-quarter material. It was finally decided to secure the flags at present, at least, and to consider the further finishing of the road at a future meeting. This hesitation and delay on the part of the council, of course, indicate a consciousness of inability to deal with the problem. Just what effect the expansion caused by the winter's frost, the thaw-out in the spring, and the following rains will have on a pavement of stone flags laid on a clay base will, of course, depend largely on the weight and frequency of traffic, but it is safe to say it will not be desirable.

Still another street demanded attention. This one was "a chain of ruts and mudholes, and really unsafe for travel." One member had the wisdom to remark that what was needed was a sufficient capital expenditure and then the upkeep would be very small for years to come. He had no further use for macadam roads, however. Another member suggested that the road should be properly prepared, a light layer of stone laid and the surface treated with tar or some similar material. However, considerations of economy (?) prevailed, and the decision was to purchase a quantity of stone and place it on the road temporarily. It can well be imagined that this will indeed be a very temporary measure, and before the taxpayers have paid the cost of one treatment the road will probably require another.

When municipal councils attempt to deal with problems that really require the attention of a "specialist" they, of course, very frequently start out wrong, and, before they realize it, are involved in considerable expenditures with little to show for them. They then hesitate to take radical measures to relieve the situation, and false ideas of economy lead to a system of patchwork, which causes a considerable drain on their funds, with negligible results. The town to which reference has been made is not a large one, but it is quite probable that the salary of a competent engineer would amount to less than is wasted in futile efforts to deal with engineering work, and it is certain,

AN OMEN OF SUCCESS

If the candidates representing Laurier — and French Canada—in Toronto and York constituencies, are representative of Laurier candidates throughout the Dominion, the Unionist—Liberal and Conservative—with red blood flowing in his veins, may well continue the battle for freedom with courage and certain hope of success. H. C. M.

at least, that it would pay the council to consult a roadways engineer rather than to trust to their own judgment in matters regarding which the members can have but a superficial knowledge.

Highway Freight Trains

HIGHWAY freight trains are now running in the United States—running over country roads from Akron, Ohio, to Boston, Massachusetts, and return, covering a distance of 1,510 miles in a week. Thus what all the good roads propaganda for the past fifteen years has failed to achieve the freight car shortage and a national crisis have accomplished. The public has been forced to make greater use of its greatest transportation asset—the country road.

The truck line from Akron to Boston is being operated by the Goodyear Tire and Rubber Company. It is called the "Akron and Boston Express." The present equipment consists of two White and two Packard trucks, of one and a half, three, and five-ton capacity. It is planned to increase the equipment, and, according to J. L. Sydnor, the company's efficiency specialist, additional trucks are already ordered.

A regular schedule is maintained. M. D. Scott, manager of garage, says they are usually on time. The schedule calls for the round trip (1,510 miles) in less than one week. Mr. Sydnor says that the express companies do not deliver stuff as rapidly as that, and that the truck costs are competing with express rates. Tires are loaded for their Eastern branches and cotton fabrics and machinery for their plant in Akron is carried on the return trip. Several trips have been made to Washington, D.C., with "war orders," and good time was made.

Messrs. F. A. Seiberling, president, and P. W. Litchfield, factory manager, are the instigators of the movement. Service was started last April, and Mr. Sydnor hopes to continue through the winter unless stopped by too much ice and snow. There is only 28 miles of unimproved road, which bothers considerably in muddy weather. The poor condition of some of the old wooden and steel bridges is another handicap. Pneumatic tires are used exclusively, at a greater cost per tire mile, says Mr. Sydnor, but with less wear and tear on trucks and roads.

The country road is at last coming into view as "the railroad of to-morrow."

C. S. C. E. Membership

The following have been elected members, associate members, and juniors of the Canadian Society of Civil Engineers:

Associate members—Messrs. J. H. Bradley, Kingston, Ont., assistant inspector of shells, Imperial Munitions Board, Kingston sub-district; C. J. Desbaillets, manager and chief engineer of public utilities of the city of Sherbrooke, formerly with the Shawinigan Water and Power and Canadian Westinghouse Companies; R. Ferguson, London, Ont., with Messrs. Archibald & Holmes, contractors, Toronto, in charge of engineering and time-keeping; F. W. Forbes, town engineer, Trenton, N.S.; J. B. C. Keith, engineer in charge of construction, city of Moose Jaw, Sask.; J. Mack, in charge of office of Green Brothers, Burden & Co., surveyors, Victoria, B.C.; R. W. McKinnon, Winnipeg, in charge of roads, bridges, ferries, and drainage, from Township 17 to North Township 33, from Pr. Meridian west to Lake Manitoba, Manitoba Government; E. H. Phillips, of the firm of Phillips, Stewart & Lee, civil engineers and surveyors, acting chief surveyor, Land Titles Office, Regina, Sask.; M. Sinclair, inspecting shells for Imperial Munitions Board at Saskatchewan Bridge and Iron Company, Moose Jaw; G. Sproule, lieutenant Canadian Engineers, engineer instructor to pioneers in France; E. D. Wilkes, Oakville, Ont., of Wilkes & Wallace, contractors in charge of works for Toronto, Leaside, and Hamilton; R. P. Wilson, division engineer, Hudson Bay Railway, The Pas, Man.

Junior—Mr. W. A. Lamont, sales engineer, Canadian Westinghouse Company, Winnipeg.

Transferred from associate member to member—Messrs. E. Brown, Montreal, professor of applied mechanics and hydraulics, McGill University; A. Potter, private practice, New York City, retained as consulting engineer on the design of a system of sewers, etc., for the cities of Wilkes-barre, Scranton, Coatesville, South Bethlehem, and Warren, and also retained by the Philadelphia and Reading Coal and Iron Company, Government of Cuba, etc.; W. Storrie, Toronto, chief engineer to the John ver Mehr Engineering Company, Ltd., on water purification plants for the city of Toronto and other places.

Transferred from junior to associate member—Messrs. A. J. Lawrence, Outremont, P.Q., district inspector of shells for Eastern Ontario; W. Walkden, Norwood, Man., in charge of bridge engineer's office, C.N.R., Winnipeg; J. A. Walker, Ottawa, lieutenant Royal Engineers, in charge of test plant and optical stores.

Transferred from student to associate member—Messrs. F. S. Small, Cedars, P.Q., with Fraser, Brace & Co., as office engineer in charge of revision of plans for extension of hydro-electric plant, principally on reinforced concrete; D. Bremner, Westmount, P.Q., with A. F. Byers & Co., in responsible charge of all construction work undertaken by the firm.

Transferred from student to junior—Mr. J. Aggiman, assistant superintendent of the Ha, Ha Bay Sulphite Company, Ltd., Port Alfred, P.Q.

Trunk Line Roads in Quebec

In connection with the good roads movement the Eastern Townships Roads Committee of the Eastern Townships Associated Boards of Trade, at a meeting in Sherbrooke, P.Q., agreed on a program of trunk line roads giving further connection with Quebec, Montreal, and United States boundary points. It is proposed to carry on a campaign in order to obtain the construction of these highways, and for this purpose the various boards of trade committees of the towns and municipalities interested will be asked to further the campaign by securing the consent of the municipalities to borrow the money required from the government. The following are the trunk roads proposed: Quebec, Danville, Richmond, Windsor, Sherbrooke, Magog, Eastman, South Stukely to Foster, one road from Foster going via Waterloo, West Shefford, Granby on to Montreal, and the other branch via Knowlton, Cowansville, Dunham, Stanbridge East, Stanbridge Station, Bedford, Pike River, St. Sebastian, Henriville, Clarenceville, connecting with the King Edward Road to Lacolle, Norton, Stanhope, Dixville, Lennoxville, Sherbrooke Road.

The Council of the Canadian Society of Civil Engineers have applied for $5,000 of the Victory War Loan.

Mill Work an Important Item in Erection of Large Frame Plant

Libby, McNeill and Libby Company's Factory at Chatham, Ont., Comprises Six Buildings Involving a Million Feet of Lumber

By J. M. Diver*

DURING the past season the Libby, McNeill & Libby Company, of Chicago, have erected a large food products plant at Chatham, Ont. The lay-out plan (Fig. 1) shows how conveniently the various buildings have been arranged. The original plan called for reinforced concrete construction, with a large additional building in front, but the plans were changed and the plant was built as shown. The office is only temporary, and will probably be moved next season and used as a storage room.

Five Buildings in Plant

The plant as built at present comprises a group of five buildings—boiler-room and tomato products building on one side and canning building, tank and process building and cabbage bin on the other side, a space of 74 feet being left between the two rows of buildings for unloading platform and two tracks.

The boiler-house is 42 ft. x 68 ft., one storey, 30 ft. in height. The foundation walls are of concrete, 9 ft. high, and brick above. Coal pockets are provided on the track side. Steel roof trusses carry the roof. The sash are also steel.

The tomato and canning buildings are both 80 ft. x 160 ft., one storey high, of frame construction, the tomato building having a mezzanine deck 32 ft. x 80 ft. and two large covered receiving platforms. The basement floors are of concrete, and the main floors of 2 in. flooring, laid on a sub-floor with three-ply slushing between, the finished floor being caulked with asphalt. Both buildings are provided with electric elevators.

The tank and process building is 80 ft. x 240 ft., one storey, of frame construction, with a second storey part 32 ft. x 64 ft. The foundation is composed of concrete piers, with brick panels between. The tank department is 80 ft. x 180 ft., and is devoted to storage tanks and vats. The process part is equipped with a waterproof floor, the basement underneath being used for storage purposes.

The cabbage bin is 40 ft. x 70 ft., one storey and full monitor, with driveway through the centre and hopper bins on each side. The basement walls are of concrete, hopper floor of concrete, and the superstructure of frame.

All buildings are connected by platforms on the track side. An underground tunnel of reinforced concrete, used for the heating system, connects all buildings.

All buildings are covered with standard five-ply built-up gravel roofing, constructed according to the Barrett Specification.

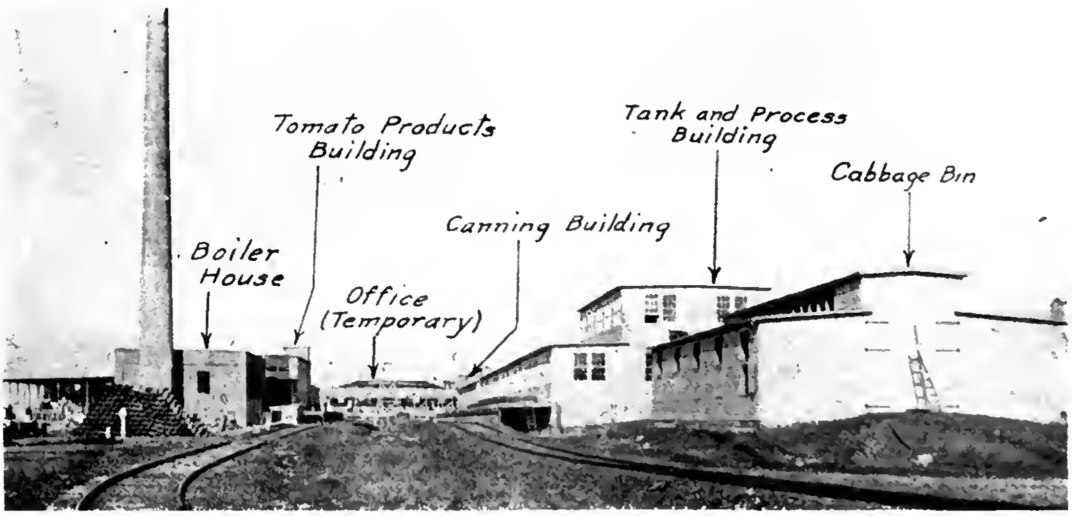
Located on Low Ground

The plant is located on rather low ground, about a quarter of a mile from the Thames River. It was necessary to keep the basements quite high in order to avoid the back water from the flood stage of the river. The drainage sewers in the basements are about two feet above the high-water mark.

The bulk of the excavation was done by a steam shovel, about 6,000 cubic yards being moved. The footers for the basement walls had to be sunk to a hard foundation. This required hand excavation, and in some cases heavy bracing for the wet clay and quicksand. A system of open-tile drains was laid parallel to the walls to get a dry foundation for the basement floors.

All of the concrete was waterproofed in accordance with the Trus-Con specifications. The basement floors are six inches thick, including a top coat of one-half inch of 1½:1 mixture. These floors were sloped one-quarter inch to the foot to centre and side gutters. The

* Manager, C. & J. Hadley Co., Chatham, Ont.



General view of Libby, McNeill & Libby Company's plant. Buildings are arranged in two rows with tracks between slopes and surface had to be exact, and the work was laid out with a transit. The top is a continuous sheet, with no joints. For about ten days the surface "sweated," and then became hard and dry.

Several Mixing Plants

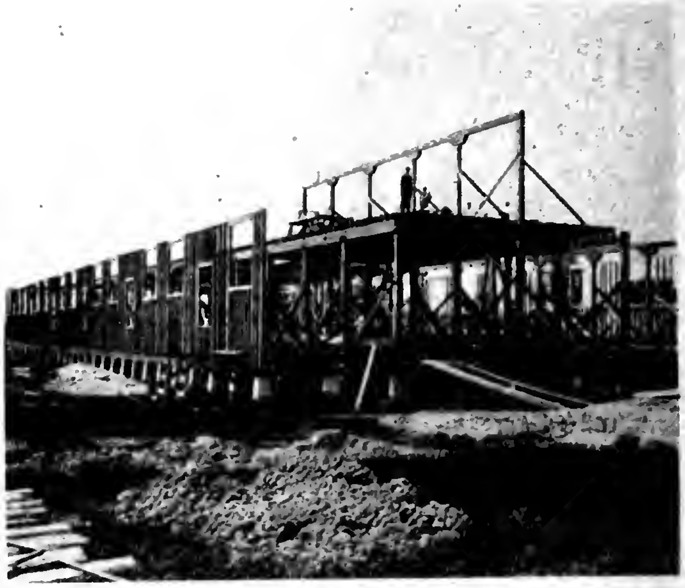
Owing to the extremely wet season and the heavy, sticky mud it was impossible to use a central mixing plant and tower. Smaller mixers were used and located at convenient spots around the plant. The water supply was furnished by the Chatham Water Department, and was placed as shown on the plan. The gravel and cement were hauled by teams, plank roads being laid where necessary.

Owing to the bad weather and general railroad conditions it was not possible to get the tracks laid between the buildings until the plant was about complete, so they were of no use during construction.

The foundation for the concrete stack was sunk to a very hard blue clay, it being necessary to go through two layers of wet sand and one of quicksand. The footer course is octagonal in shape, and is 27 ft. 3 in. between parallel sides. The stock is 154 ft. high, with an ornamental top.

Mill Work an Important Item

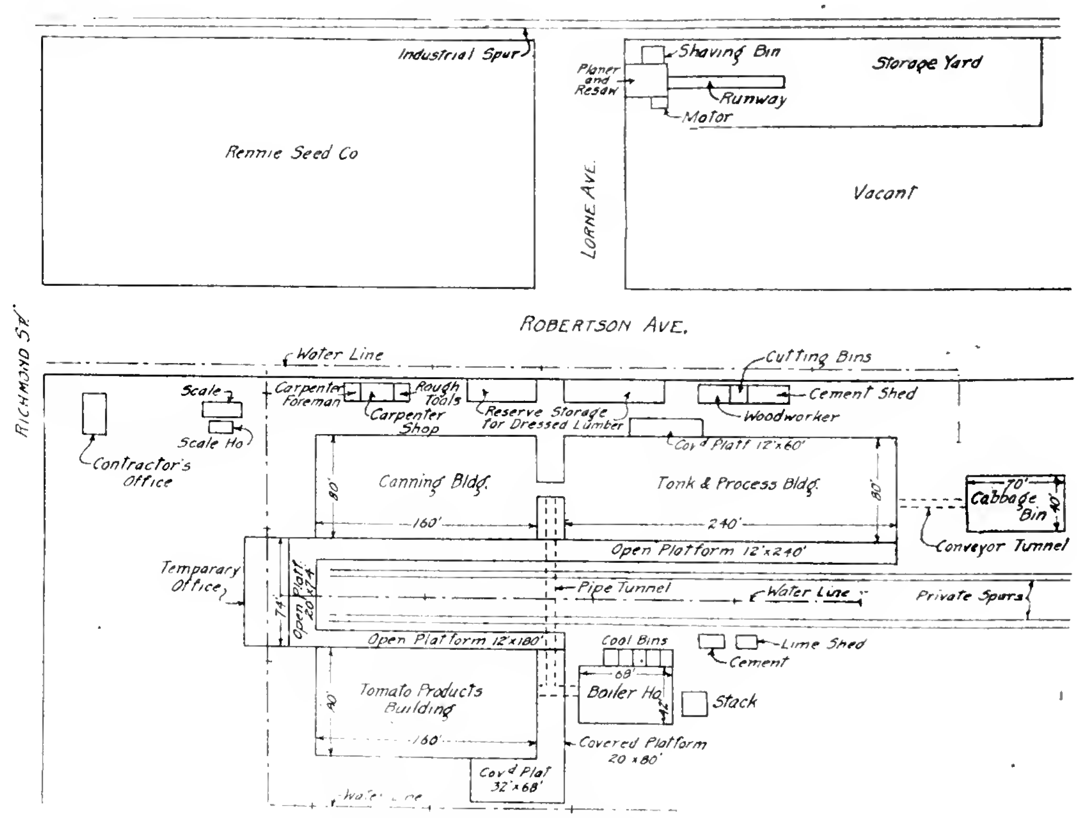
The buildings being mostly of frame construction, the lumber and mill work became a very important factor of the material department, the total requirements in this line amounting to nearly 1,000,000 feet of timber and dimension and 120,000 feet of mill work, frames, etc. The timber and dimension specifications called for long leaf yellow pine and British Columbia fir, all surfaced on four sides. It was found impossible to get other than mill delivery on surfaced stock of the required sizes and no definite time of shipment. To



Buildings are of frame construction.

meet this difficulty transit cars of rough stock were picked up by the lumber department and diverted to Chatham. In the meantime a stock yard was established near the industrial spur, as shown on the layout plan, and in the short time of three weeks all the timber and dimension had been delivered and properly piled, ready for milling.

A small mill shed was erected in connection with the stock yard and a 16 in. x 24 in. four-side surfacer and matcher installed. All the surfacing and matching was done on this machine, the material being handled to the machine by a system of rolls and tramway. A large band resaw was also brought into use for resaw-



Layout of plant and contractor's equipment.

ing all larger sized timbers to the proper dimensions, the cuts or offals being worked into dimension stock.

Portable Woodworker for Light Framing

The stock yard and mill were placed in charge of a competent mill man, who got out the material on orders from the carpenter foreman and delivered it as directed by him.

A reserve stock pile for small dimensions and finishing material was established near the main buildings, as shown. A portable woodworker was housed nearby, and a large amount of light framing and cutting was done on this machine. It was originally decided to move the woodworker from place to place as needed, but it proved more advantageous to keep it near the stock pile. In this manner all cuttings were in one place, and no time was lost by the woodworker, the cuttings being worked into bridging and lookouts when

Interior view showing frame construction and wood floor. Floors are double with slushing between.

the machine was free from framing. The small items were stored in part of the woodworker shed, and were always ready for use when needed.

Lack of Experienced Carpenters Handicapped Work

The contractors were greatly handicapped by lack of experienced carpenters and helpers, and the organization plan for this end of the work could not be carried out in the manner desired. However, the following system was adopted, and, after a short time, proved satisfactory.

The work was in charge of a general carpenter foreman, assistant foreman, and two gang foremen. The carpenter and helpers were divided into three gangs, namely, framing, erecting, and sheathing gangs, care being taken to have a few experienced men in each group. After the buildings were enclosed the men were again divided, the more capable being worked on the interior finish, siding, etc., while the balance were placed on platform work. In this manner the work was carried forward promptly, and all carpenter work completed within seventy-five days.

The plans for the plant were prepared by Philip Larmon, architect, of Chicago, Ill.

The contract was let to the C. & J. Hadley Company, of Chatham, the plant being constructed by the George W. Cutter Company, of Chatham, Ont., and Meadville, Pa.

Paving Brick Manufacturers Urge Continuance of Road Work

AT the annual meeting of the National Paving Brick Manufacturers' Association, held in Cleveland, Ohio, on November 19 and 20, the following officers were elected for the ensuing year: C. C. Blair, president; J. L. Murphy, vice-president; Will P. Blair, secretary; C. C. Barr, treasurer.

The following important resolutions were passed unanimously:

"Be it resolved that there be a committee appointed by the president of the association, the members thereof to include the president of the association and its secretary and four other persons, to be selected by the president, whose duty it shall be to represent the association industry in matters affecting the industry arising out of any governmental relationship."

Correlation of Efforts

"Be it resolved, further, that in order to increase the effectiveness and influence of the association in all matters affecting the welfare of the paving brick industry that the membership committee be increased to five in number, the secretary ex-officio to make the sixth member thereof, and that this committee be the association, but that they be and are hereby specially charged with seeking conferences with allied and local associations for the better correlation of efforts, unity of action, and especially a finding out of charged not only of actually securing memberships in reasons, if there be any, why any single manufacturer or group of manufacturers remain out of membership in the national association. In connection with this duty the special purpose therefor is found in the great necessity for the amplification of funds for an effective advertising campaign."

Continuation of Improvements

Reports regarding the continued improvement of streets and roads gathered from over one thousand cities and from various states indicated a preponderance for the prosecution of such work exceeding 75 per cent. The progress with which such work is proceeding, according to reports, shows an average of less than 75 per cent., compared with 100 per cent. normal.

From every source it was conceded with but slight exception that street and road work at this time was of the utmost importance.

The reports indicating the measure of public sentiment with reference to street and road improvement naturally led to a discussion of market conditions which embraced all angles of the subject—transportation, labor, fuel, on the one hand, and the great demand and insistence for improved highways over which may be moved the freight of the country which the railroads are unable to care for.

A multiplicity of instances were cited where truck movement over highways enabled industrial establishments to run independent of railroad service. After two days' consideration of market conditions, transportation difficulties, and the government's necessity for winning the war in the movement of food and supplies, a unanimous conclusion was reached that road improvement was a war necessity, and that it must be continued with all possible energy.

The Contractor's Superintendent

Paper by W. A. Rogers of Bates & Rogers Construction Company Outlines Importance of this Official and His Duties

WHEN a contractor secures more work than he can handle personally it becomes necessary for him to employ some one to manage at least part of it. This employee is ordinarily called a superintendent. His duty is to represent the contractor in the management of the work and in his dealings with the principal or client. The authority he may have in any case depends upon the people he is working for and upon himself. He may, in reality, represent the contractor, both in the management of the contract and in his dealings with the client and others. For all practical purposes he is the contractor, managing the work in all its details, and being responsible for results only. In this case the general policy would be laid down by the contractor, and the plant to be used and its layout would be settled in conference with the contractor. The superintendent would deal directly with the client and would settle minor matters without reference to the employer. Even in this case the superintendent is necessarily guided by the general policy of the company, especially where it affects other contracts which the company may have. In other cases the superintendent may be required to refer every little detail to his employer, either because he is not big enough to have greater responsibility placed upon him or because the employer himself desires to handle all details. The ideal case is one in which the superintendent is big enough and competent enough to manage and is responsible only for results.

Superintendent's Duties

Under our plan of organization we place a superintendent on each contract. If the work is all in one location and of sufficient size, the superintendent usually has a general foreman on whom the details of the management fall, and to whom the various foremen report. If the work is scattered, there may be one or more assistant superintendents, or in the case of grading work, what is known as a walking-boss. All clerical work is handled by the superintendent's clerk, who has such assistants as he requires. To him the timekeepers, material men, and commissary clerks report. When the contract is of sufficient magnitude, an engineer is assigned to the superintendent. His duties are to measure and keep track of the work done and make any plans or calculations which may be required. He might, for instance, be called upon to make a plan of a pile-driver, or design sectional concrete forms, or sketch the layout of the plant. He is expected to check with the client's inspectors and engineers, to make sure that our work is correctly measured and classified. A position of this kind offers excellent training for that of superintendent. You will notice that this organization is practically the same as if the superintendent were a contractor with only one job.

To give you an idea of the superintendent's duties we will follow through the operation of an imaginary contract. The first thing to be done is to prepare the bid for the work on which we have been asked to make a proposal. In order to learn the local conditions we first have one or more of our superintendents investigate the proposed work on the ground. They examine the foundation sites, the material to be excavated, and the location of sand and gravel pits; determine the available local supply of all other materials, and look up the roads from the nearest railroad over which material may be hauled, the local supply of labor, and the prices to be paid for both labor and material. A study is made at the site, of the method of handling the work and the plant required. After finishing the local study they investigate other points from which materials may be obtained and determine what the material from such points will cost.

Estimating the Cost

After these investigations have been made the next step is to make an estimate of the unit cost of each item in the contract. This estimate is based on the cost of labor and material for each item, plus a proportion of the general expense. The term "general expense" includes items of expense not covered by labor and material, such as superintendence, liability insurance, bond, depreciation of plant, small tools, supplies, fuel, traveling expenses, buildings, loss on camps, and innumerable other items. Costs should be based upon records of similar work, adjusted by judgment to fit the work in hand. After the men have prepared their estimates of costs, a consultation is held and their figures are subjected to a critical analysis, each item being considered in detail. There are often wide variations in ideas regarding costs, which must be threshed out and reconciled. When the revised estimate of cost is finally agreed upon, it ordinarily represents the combined judgment of three or more men. The margin of profit desired is now added and the bid made up and presented to the prospective client.

If the proposal is attractive and the work is awarded to us, a superintendent is assigned to the contract and his job of organizing begins. A general foreman, experienced in that particular line of work, and a clerk, are detailed from our organization. Then foremen, timekeepers, and the rest of the organization are selected. In the meantime, in consulation with our office, the method of handling the work is fixed, the plant required is determined upon, and the assembling of the same is started. The successful outcome of the contract depends to a large extent upon the proper selection of the plant and the proper layout of the work. For instance, if grading is under consideration, is it steam shovel, drag-line, or team work? If shovel work, how large a shovel and what size of cars are to be used? Does the work require standard gauge equipment, with heavy locomotives and 12, 16, or even 24-yard cars; or, are smaller cars, with narrow gauge "dinkies," best? And so each detail must be decided upon. If concrete work is under consideration, the type of distributing system must be decided—whether the chuting system will be employed or whether the concrete will be distributed by cars or by buckets handled by derricks. Then the mixing plant, with charging-hoppers and other details, must all be worked out. Any new plant required is bought, and that which we have in stock is loaded and shipped to the work. It may come from other contracts where it is not needed or from a storehouse. In the meantime arrangements for materials have been made. On securing a contract, we ordinarily protect ourselves as far as possible by closing for all of the material required during the life of the contract.

Shaping Up the Job

The superintendent, with a nucleus of his force, gets on the job, picks his camp site, builds camps, puts his roads in shape, gets the material, plant, and organization coming, and starts work. The selection of a camp site is an important matter, depending upon the lay of the land, water supply, accessibility, and many other considerations. With the help of the general foreman the organization is licked into shape. It is now up to the superintendent to keep his eye on the job and keep it lined up. He must so organize and handle the work that every one pulls together, so that it goes along with a swing. Of course, this is impossible unless he plans each operation in advance, and every foreman or straw-boss knows before he is up against it just what he is going to do next. It is possible on going onto a job to feel that everything is going along swimmingly or that the work is disorganized. Just as one riding in an automobile can tell whether every cylinder is working or whether one or more of the cylinders are missing, so you can tell whether or not the force is hitting it up well.

As soon as possible after getting started it is our plan to have the superintendent make out a schedule showing the dates upon which he plans to start and finish each operation. For instance, if he is building the substructure of a bridge, he estimates the date of starting and finishing the excavation for each pier or abutment; when he will build each cofferdam; start and finish pumping; start and finish driving piles; and start and finish the concrete. This schedule is made up with the idea of completing the work well ahead of the completion date named in the contract. The dates are revised from time to time as the work progresses. There are many advantages in having this schedule. In the first place, it means that the man in charge, in order to make it up, must necessarily plan the job through in all its details. He has before him at all times a schedule of what is to be done next, and it keeps him prepared for the next move. Then, too, his organization will have a pride in keeping up with or beating the schedule. It acts as a pacemaker for the men on the job. It serves as guide by which the main office can check the progress of the work from time to time.

Must Keep Things Running

As the job progresses the superintendent is constantly in touch with the client. In addition to handling his actual work he must see that the engineers furnish him plans and instructions, and make their decisions far enough in advance that he can properly arrange for each operation. He must keep everlastingly after the engineers to have them prepare for the work, or he runs the risk of being tied up. Engineers often do not realize the importance of giving instructions as far in advance as possible so that the contractor may look ahead in his preparations. The superintendent, or his assistants, must constantly keep after the delivery of material required. There is rarely a good excuse for for getting out of material.

A good superintendent has constantly in mind two things. First, in order that the contractor shall stay in business he must turn out good, honest work, and make friends of the clients by doing a first-class job and completing it on time. In other words, quality of output should be his first consideration. He may occasionally have to restrain over-zealous foremen who have the idea that it is to the advantage of his employer to skin the work. Secondly, the good superintendent must also remember that, in addition to turning out a first-class job, he must do so at a profit, or his work is not a success. To do this he must be everlastingly after the loose ends, watching for improvements of methods and for economy of materials and supplies. He must look out for close buying, cut out unnecessary work, and in every way lessen the cost of construction. With this in mind, he should know at all times what his work is costing. He should keep, from day to day, the costs of the different units, in order that he may know at all times how these costs are running. He must be able to put his finger on any trouble before it is too late. Each man naturally will work out just how he can best handle this personal cost check. These data would be more in detail than that required by the general office.

During the progress of the work a diary, or log of progress, and running history of the work should be kept. This should cover a record of any orders or instructions that have been given. This record is important as history to settle any disagreements which may arise. Each day's notes should be initialled by the superintendent or by the person involved in any occurrence of importance. When the contract is completed the final estimate is checked, and any adjustments of matters which may have been held open until the end are taken up and settled.

Training Men for the Position

How are men trained for this responsible position? We believe the best way is to train the men inside the organization—from the bottom up. Starting at the bottom, the man becomes familiar with the duties of the men in the various steps of progress upward; he becomes saturated with the ideals of the company, and becomes familiar with its particular methods of handling the work and system of cost records; he gets to know the men.

He may start as a timekeeper, or commissary clerk, as material man, or even as a laborer, rising through the position of engineer on the work, or through foremanship, or through a clerkship in the office. It is largely a question of the qualifications and capabilities of the man as to just the line he takes. The things which go to make a successful superintendent are largely the same as those which make a successful contractor. These qualifications are both business and moral. He must be a good executive, able to judge men, able to place his forces so that each man is in the position for which he is best adapted. After organizing his force, he must be able so to inspire the loyalty of his men as to get the best out of them that they are capable of giving. His men will not be loyal unless he treats them fairly. I do not mean by this that he must be easy; an easy boss is never respected. He should know what a day's work is and be able to get it out of his men.

The good superintendent will take good care of his men and will furnish a good camp and substantial food. He cannot expect good work unless his men are well cared for. A good business head is a prime necessity. He will deal with all kinds of men, and he must have the business instinct so developed that he can see quickly whether any particular act will pay as a business proposition. He must have ever before him the thought that he is there to make a profit for his employer.

Practical Knowledge Needed

Practical engineering sense well developed is a valuable trait; and, while theoretical engineering knowledge is a good thing, what is really wanted is what I would call common sense or practical engineering knowledge. What I mean is that in addition to knowing why a thing is done or how to figure it out theoretically he must know how to do it right at the least cost—that is, how to construct economically what another man has designed. A detailed knowledge of the various pieces of machinery employed on the work is a fine thing, and the ability to operate any part of the plant if it becomes necessary is very valuable. The man who can run a hoisting engine has an important acquisition. The good superintendent must be able to make decisions promptly and be quick to act in an emergency.

Many emergencies arise when the superintendent must know what to do "right off the bat." I often think that the superintendent's training should fit him to be a diplomat, for he surely must use diplomacy in his dealings with his men as well as in the dealings with the engineer and client. The faculty of being able to get along with people is one that has definite value in money. It costs money to be constantly at variance with those for whom one is doing work. The habit of looking at things from the other fellow's standpoint as well as your own is a good habit to form. The other fellow, in the majority of cases, intends to treat you right. What should be done is to get him to see things from your point of view. If you make him angry it is almost impossible to accomplish this. It may be very exasperating to have a young engineer, just out of school, full of theoretical knowledge but without experience, lay down the law and try to tell the experienced superintendent, who is conscientiously working for the employer, what to do. But it is the business of the superintendent patiently to train the young engineer in practical work, to make him understand that both work for the same end and that the best results are obtained by working together rather than at cross-purposes.

Character

A truly successful superintendent must be a man of good habits, of good moral character, and have high ideals. He must realize that honesty is not only the best policy but is right, and that it pays to have the reputation of doing honest work. A good address is a valuable asset. While appearances are only on the surface, sometimes the first impression made by the outward appearance is of vital importance. If practicable, the ability to express one's ideas clearly and forcibly in good language is invaluable. The ability to go on a job and take it all in is also important. The habit of observation should be cultivated. Loyalty to the employer is, of course, essential. The man who does not have this quality is in the same class as he who receives money under false pretence. If you are not in sympathy with the people you work for you should get out. I believe that the superintendent should be constantly striving to widen his acquaintance with engineers, contractors, and others with whom his company may later have business relations. He must always keep his eyes open to see how the other fellow does his work, ever ready to select better methods than those he is using. In doing this he broadens his viewpoint and becomes a better engineer.

I have left to the last two of the most important qualifications without which I believe it is impossible to become successful. The first is the willingness to assume responsibility. It is far better to do something and do it wrong than to do nothing. The man who is always waiting for someone to tell him what to do and how to do it does not get anywhere. Take responsibility and put all that there is in you to do right what you have assumed to do. The other qualification is what I call "stick-to-itiveness." The quitter should never enter the contracting game, for there is no place for him in it. What is wanted is the man who does the thing he starts out to do, in spite of good reasons why it cannot be done; who does not know when he is beaten; who does not know how to quit. If there is a "yellow streak" or quitting streak in a man he should never start in a career leading to that of a contractor's superintendent. We have in our organization men who when they set out to do a task do it. We simply forget that it is to be done, and assume that it is as good as done when it is turned over to them. That is the kind of man wanted as superintendent, and that kind of a man in bound to succeed.

Present Position and Future Prospects of Canada's Iron and Steel Industry

By D. H. McDougall*

IN reviewing the iron and steel industry in Canada, a clear distinction must be drawn between the position during war time and the position that may be forecast after the war.

The present condition of the steel and iron industry is one of artificial stimulation, brought about by the action of numerous temporary factors, prominent among which are: Extraordinary demand for munitions steel; increased cost of transportation, accompanied by congested railroads, and shortage of shipping; an unparalleled coal shortage; and a severe and increasing shortage of labor.

These factors, all abnormal and arising out of war conditions, have rendered temporarily obsolete all hitherto accepted standard of economics, and they have been accompanied by an increased cost of living, large increase in wages, and increases in the selling prices of steel and steel products. No one can say how far these extraordinary conditions will extend, or how long they will last, but some day the world will resume its normal course, and the laws that govern normal times will again operate.

Therefore, in considering the after-war situation of the Canadian steel industry we should see what the permanent essentials of a successful steel industry are, apart from present unusual and evanescent conditions.

Conditions Favorable to Iron and Steel Industry

Factors that favor success and permanence in steel and iron manufacture are:

Geographical location, giving cheap access to world markets, and opportunities for the cheap assemblage of raw materials.

Close proximity of metallurgical coal, iron ore of good grade, and limestone deposits of suitable quality. All these raw materials should be accessible in large

* General Manager Dominion Steel Corporation, in Canadian Mining Institute Bulletin.

quantities, and so placed as to render mining costs and transportation reasonably cheap.

A review of the iron ore and coal deposits of Canada will show that such a combination is to be found in very few places in Canada, and that already large steel and iron works exist at the localities where the manufacture of iron and steel is permitted by natural conditions to rest upon a permanent and commercial foundation.

Proximity of Coal Necessary

The location of iron and steel plants in all parts of the world has been primarily determined by the proximity of coal, and it does not seem probable that any steel plant can exist and pay profits in normal times which has not to hand a plentiful and inexpensive supply of metallurgical coal. It is perhaps hardly an exaggeration to say that the steel industry is always an outgrowth of a coal mining industry.

Present conditions favor the commencement of small war industries. For example, the time is opportune for the opening up of small and easily accessible coal areas, the operation of which in normal times was not profitable; and in the same way small smelting plants and small works for making munitions have been commenced and successfully worked because of the unbalanced state of demand and supply. These passing conditions, on the other hand, act to the disadvantage of large and long-established concerns, or at the most they offer merely an opportunity to get rid of the load of debt that is the legacy of the depression that preceded the war and persisted for some time after hostilities commenced.

After-war conditions will eliminate most of these small ventures, and in the days of financial stress that are surely coming, the mainstay of industry and the hope of the country will be the large and long-established companies who, if they are wise, will have stored financial reserves and expended profits on rehabilitation of plant, as a safeguard against the future.

Future of Steel Works Should Be Secure

Applying these general principles to specific cases, it would seem advisable that the energies of the country should be concentrated on ensuring the future of the large steel works on Sydney Harbor and on the Great Lakes, and that these existing works should be looked to for the production of steel and iron in large quantities, because in these places only is there available a sufficient quantity of coal, iron ore, and limestone.

For the treatment of steel in small quantities to produce tool-steels, crucible-steel, and special alloyed steels, the electric furnace has a future, and industries of this kind will probably increase in the populous parts of Quebec and Ontario.

It is also advisable that any increase in the rolling and forging capacity of Canadian steel works should take place at the large and established plants referred to. These plants have hitherto regarded the manufacture of rails as their chief activity, but in the future, and with a view to after-war conditions, it seems probable that the rolling of ship-plates and other commercial shapes will become necessary. It is self-evident that the manufacture of finished steel products can nowhere be so satisfactorily and economically carried on as at the existing plants.

What Are Future Requirements?

Considering particularly the question in what way it may be possible to obtain some considerable increase in the production of iron and steel in the future—that is, after the war—the first point to be determined is: Allowing for the rolling in Canada of steel shapes and forgings now finished outside of Canada, for all the export business obtainable, and for all Canada's own requirements in iron and steel, what tonnage of iron and steel over and above the existing capacity of Canadian works will be required?

Summarizing, and applying these principles, it would appear that the Canadian steel industry should be guided towards two main ends, namely:

That the present abnormal demand for steel should be supplied as far as possible by the extension of existing plants.

That these existing plants should prepare to enlarge the variety of their finished products.

That should it then appear there was a necessity for greater production of iron and steel such as to require new plants, these plants should comply with the factors that have already been named as requisite to commercial permanence, and as giving ability to compete in world markets.

By following along these general lines the existing plants will be extended, rehabilitated, and modernized, and given an opportunity to accumulate financial reserves to carry them successfully through the troubled days ahead, and they will be placed in a position enabling them to enter world markets, and to compete with other countries, particularly the United States.

American and Canadian Societies of Civil Engineers will Co-operate

Recently the Council of the Canadian Society of Civil Engineers received from the Board of Direction of the American Society of Civil Engineers resolutions offering hearty co-operation in establishing more cordial relations between the two societies, with a view of working in harmony in the interests of the engineering profession. The Council of the Canadian Society, at its last meeting, warmly welcomed the proposal, and passed resolutions thanking the Board of Direction of the American Society for the cordial spirit displayed and offering reciprocal privileges to the members of the American society. A committee was appointed to carry into effect the spirit of the resolutions of the two societies. This will probably result in joint meetings being held to the mutual benefit of engineers on both sides of the line.

Fuel from Toronto Garbage Suggested

A proposition has been made to the Toronto Board of Control by the Nu-Fuel Company regarding their process of manufacturing a new fuel from city garbage. This fuel is claimed to have a higher heat value than coal. Under one plan the city would erect its own plant and use the process of the company on a royalty basis. Another suggestion is that the company operate the plant and the garbage and refuse be furnished by the city. Such a plant, it is pointed out, would have many by-products. Metals would be taken care of in a special melting furnace, rags would be washed and sterilized, glass, grease, etc., would be salvaged. From the free garbage a fuel known as "Oakoal" would be manufactured. The matter was referred to the Street Commissioner and the M.O.H. for a report.

The annual meeting of the Canadian Society of Civil Engineers will be held on January 21-23, at the society's rooms, Montreal.

New Method of Foundation Construction

Completion of Steel Pile Foundation for Heavy Building Delayed Until Erection of Superstructure has Proceeded

A RADICAL change in ordinary building methods has been made practicable by a new development in the construction of foundations in sand for heavy buildings. The new method which has been applied to the deep foundations of tall office buildings in New York has effected an important economy of time and cost by the combination and amplification of features already adopted for other uses, so that the new method, although novel as a whole, is neither unusual nor experimental in detail.

By its use the installation of much heavy plant and the sinking of pneumatic caissons or deep cofferdams has been avoided, a large amount of heavy pile-driving eliminated, unequal settlement of foundations and uncertain loading of piles prevented, and much of the time heretofore used exclusively for foundation work has been saved, so that, after the site is available, the erection of the superstructure is commenced, and can be completed several months sooner than is ordinarily the case. A particular application of this method is described in "Contracting."

Conditions, Requirements, and Time

The 110 William Street office building, with fronts of about 69½ and 121 ft. on William and John Streets, New York, is a steel cage building, with twenty storeys above the curb and two storeys below. It has in all thirty-seven columns, most of them loaded with 1,000 tons or more, and is built on a stratum of fine sand and clay overlying rock about 120 ft. below the curb, with ground-water level about 28 ft. below the curb.

Twenty-four of the columns are located in the exterior walls and the remaining thirteen columns are supported on eleven separate footings.

It was required that the foundations should have abundant capacity and stability and should be safe against any probable disturbance of the soil by future construction of adjacent deep foundations.

In accordance with ordinary New York practice under such conditions, long piles driven to refusal or piers carried to rock were considered. The character of the soil and the depth of the rock made open cofferdam work impossible and pneumatic caisson work very costly, while steel piles, if driven to rock or to refusal, would have required much severe driving, making their installation a slow and expensive operation.

In competition with these methods the contract for foundations was awarded to Smith, Hauser & MacIsaac for a foundation consisting of large hollow steel piles sunk to a comparatively small depth, filled with concrete before the building was erected and subsequently driven to refusal, tested to 50 per cent. above their working load, and permanently connected to the substructure during the erection of the lower storeys of the superstructure, thus providing a high-class, permanent foundation with a large factor of safety at a cost materially less than that of the other kinds considered, and so quickly ready to receive the columns that it expedited the completion of the building by about six months.

Installation of Piles and Construction of Piers

Adjacent buildings were underpinned with new footings where necessary, and the general excavation was carried down to a depth of about 24 ft. below curb level. Pits and trenches were sheeted down to an average depth of 9 ft. more, being about 4 ft. below ground-water line, as required for a continuous concrete footing around all four sides of the building and for the eleven piers for interior columns.

As the pits were excavated they were drained by pumps, and a total number of 525, 19-in. sectional steel piles from 5 to 10 ft. long were driven by sledges. The earth in them was excavated by long handle scoops and the piles were filled with 1:2:4 concrete, made with Lehigh cement and gravel. When the concrete was about 24 hours old a small portion of it was removed close to the top of the steel shell, to provide clearance for the connection of an additional upper section if necessary. After the concrete was sufficiently set, 12 x 12 in. short vertical posts were set on top of the piles, with their upper surfaces in the planes of the bottoms of the foundation piers.

The pits were then backfilled to the tops of the posts, care being taken in case of the deepest ones to spread a few inches of gravel in the bottom and set on it an open pile length to serve as a sump after the pit was backfilled. Where necessary forms for the foundation piers were built in the pits and trenches, reinforcement bars were placed, and the concrete, mixed in a chain-belt machine, was discharged into buckets, hoisted by the derrick, and emptied into a hopper on a low wooden tower, whence it was chuted into cars on an elevated runway that delivered it to the different forms. Sand and gravel delivered by trucks in the street were shoveled by hand into the mixer hopper.

The trench for the exterior column footings was 7 ft. wide, sheeted with horizontal 2 in. boards braced by transverse struts bearing against 2 x 12 in. vertical strips covering the butt joints of the sheeting. The footing, 4 ft. 4 in. wide and 4 ft. deep, was reinforced by 28 longitudinal bars 1¼ in. square and transverse stirrups, thus forming a very massive continuous girder competent to distribute the 1,000-ton column loads for a considerable distance. Under these girders the short foundation piles are arranged about 30 in. apart, in an outer row, and in groups of two or more under the columns adjacent to them in an inner row.

Loading, Testing, and Driving the Piles

Pits were dug alongside the piers and the backfill excavated under them in successive sections, exposing the tops of the piles and the wooden posts seated on them. The posts were successively removed and a pile cap placed on each pile. Then a 175-ton Watson-Stillman or Dudgeon hydraulic jack was set on the cap blocked up against the concrete footing above and operated until a pressure of at least 75 tons had been applied, usually driving the pile from one to three feet deeper into the sand and maintaining it there until further penetration ceased.

After the jacking under the piles was finished a pair of vertical steel columns was placed on the cap, one on each side of the jack, and wedged against bearing plates on the under surface of the concrete footing until each of them had taken a load of about six tons. The jack was then slacked off and removed, transferring all the load to the wedging columns and preventing any upward displacement. Thus all the piles under the footings were tested, the loads transferred permanently to them, and ample stability provided for a working load of 50 tons on each pile without any probability of future settlement, the sand under the pile having already been compressed considerably in excess of maximum permanent loading.

After the piles were thus loaded the pits around them were filled with concrete up to the bottom of the old footing, thus increasing its depth four or five feet and adding to the stability of the structure.

To prevent the formation of cavities short pieces of grouting pipe, usually one for every pile, were built in the upper part of the concrete footing in vertical or inclined positions.

As soon as the foundation piers were sufficiently seasoned I-beam grillages were set on them to distribute the column loads, and the erection of the steelwork superstructure was commenced. After this had been carried up to a height of about four storeys, operations were commenced to complete the driving of the foundation piles and to subject them to test loads and initial compression much greater than they will endure in service.

Piles, Caps, and Columns

The cylindrical piles were made with riveted sections 2 ft. long of 7/64 in. steel plates connected by inside sleeves 4 in. wide made of the same material.

The pile cap was a solid casting about 3 in. thick, with a circular projection on the under side to fit the interior of the pile. The casting was made longer than it was wide, affording bearing for the hydraulic jacks in the centre and for the wedging column on each end. A small hole through the centre of the casting was provided to act as a sort of vent when the casting was bedded on soft mortar covering the top of the pile, and thus allowed any air to escape and permitted mortar to rise through the hole, ensuring perfect bearing on the under side of the plate.

The vertical wedging columns were nominally 6 in. I-beams or their equivalent, safe for loads of more than 25 tons. For convenience short lengths of heavy 12 in. I-beams from the contractor's stock were cut in two along the centre line of the web by the oxy-acetylene torch, making two heavy T-sections, each consisting of one flange and half the web, which made more convenient and efficient columns than the regular 6 in. I-beams would have. The work was done in about six months by a force varying from 10 to 35 men.

Splicing and Lacing Belts*

TRANSMISSION belts can be made endless at the factory, providing the proper details, in regard to their exact length, have been furnished. This practice is recommended on the basis of the superior facilities in the factory for handling this work efficiently. Sometimes, however, it is either necessary or desirous to do this on the pulleys. There are many ways of splicing rubber belts, but the following method would seem to be the most satisfactory for users to adopt:

To ensure a good joint use about three feet of belting for the splice. Cut the belt ⅛ to ¼ of an inch shorter—according to its size—for every foot in length than the actual distance between and around the pulleys.

Step off the ends, as illustrated, allowing the following suggested length of lap per ply, according to the size of belt:

Belt width.	Length of lap.	Belt width.	Length of lap.
Up to 4 in.	3 in.	14 to 20 in.	9 in
5 to 12 in.	6 in.	20 in. and over	12 in

Use a heavy, sharp knife to ensure all ends being perfectly cut—not jagged. Better true up the steps with a set square.

Avoid irregularities in the steps that prevent one from fitting snugly into the other. No one step should reach over the other more than one-sixteenth of an inch, nor should any space be left between them. Remove the sharp edges by trimming the ends of each on a bevel. Distribute evenly three coats of cement, allowing each coat to dry before the application of the next is made.

When the last coat becomes "tacky," and after all gasoline has evaporated, finish the operation by joining the plies together, being sure to butt the ends accurately; then thoroughly roll down with a metal roller.

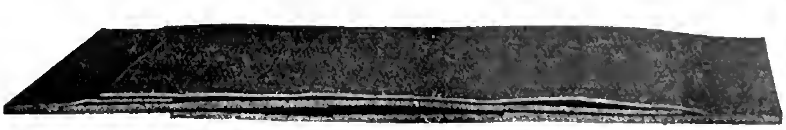
Machine for Splicing

To secure the best results, and to eliminate all possible stretch, it is expedient that the belt be reasonably tightened by draw-clamps before fastening the splice. The small and inexpensive machine, illustrated herewith, is a very efficient apparatus for this kind of work. This press is recommended for making the endless joint. The whole job can be completed with it, either in the shop or at the drive over the pulleys. To prevent the belt adhering to the press, place pieces of tin on both sides and moisten with soapy water.

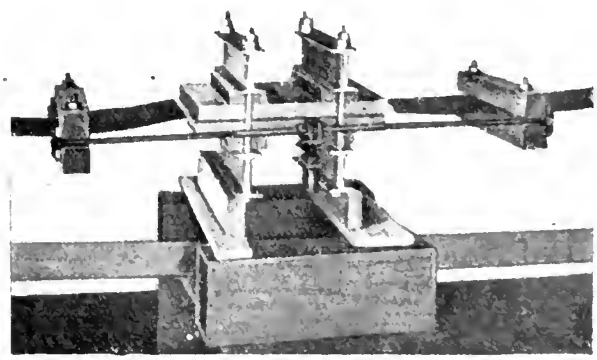
Always be sure that both sides of both ends of the

*Contributed by Dunlop Tire & Rubber Goods Co., Ltd.

Plies are cut away to make a "step" splice.



How stepped ends match—Belt runs to right.



Machine for making belt splices.

belt are pulled evenly, so as to prevent a crooked joint. Do not remove the press until the belt is well set. To further safeguard your work stitch the joint in rows, one inch apart. Do not cut the thread at the end of each row. As far as possible make it continuous.

A joint, if made as recommended, will be absolutely as strong as any other part of the belt, and it will be difficult for anyone to detect the splice.

Belt Lacing

Although fastening the ends of belts together by the use of a leather lace, as described below, is probably the most popular method employed, the metal fasteners illustrated are found to be very satisfactory on sizes up to 12 inches. Much better results can be obtained through splicing belts over 18 iinches wide by the method explained previously.

While there are many ways in which lacing can be done, the method illustrated below is most simple and effective.

The following table will give approximately the number of holes, which should be cut with either an oval or round punch, and which it is advisable to make in the different widths of belting:

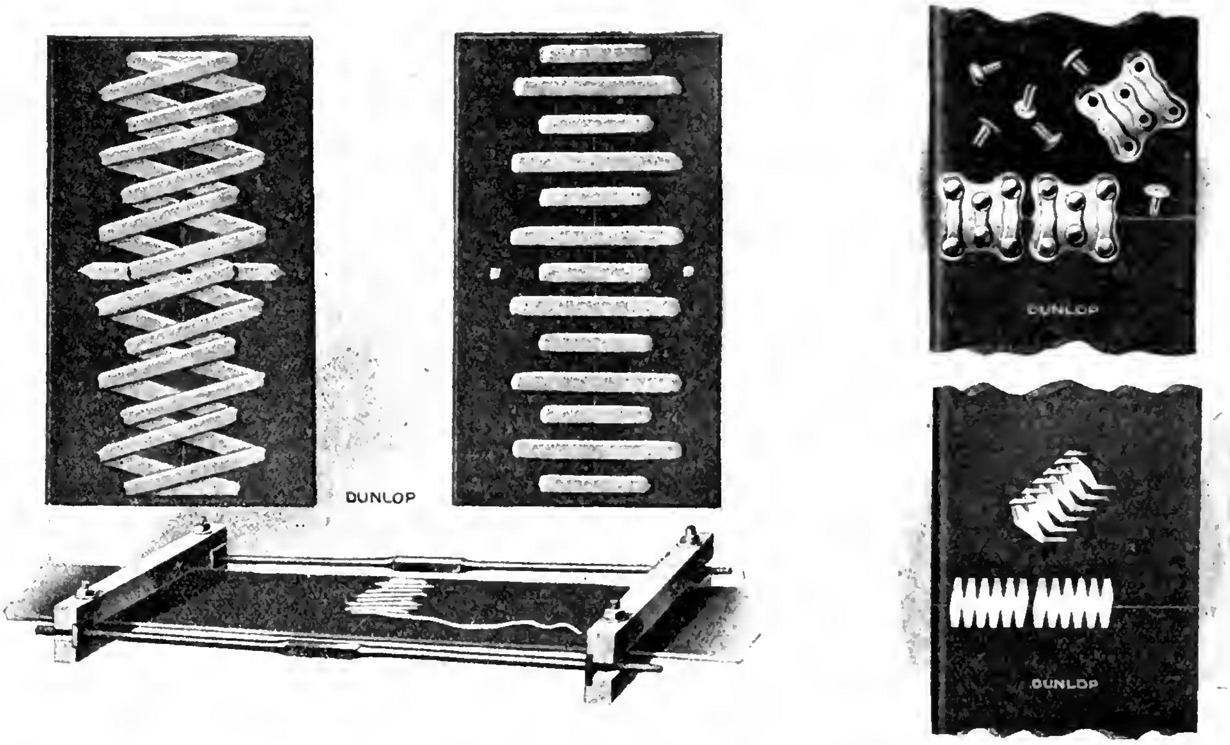
2 to 2½ in. belting	3 holes
3 in. belting	4 holes
4 in. belting	5 holes
5 in. belting	6 holes
6 in. belting	7 holes
8 in. belting	9 holes
10 in. belting	11 holes

The holes should not be closer than one-half an inch from the edge of the belt nor nearer the end than five-eighths of an inch, and should only be large enough to take the lace drawn through tightly.

The widths of lace generally used are as follows: Belts up to 5 in. wide, 1/4 in. and 5/16 in.; belts from 6 in. to 12 in. wide, 3/8 in. to 1/2 in. Do not employ too heavy a lace, as it will form an unduly large ridge, which will cause the belt to jump and pound on the pulleys to an injurious extent. In narrow belts, butting the two ends together and lacing is generally sufficient, but fairly wide belts require the addition of a piece of rubber-frictioned duck on the over-side.

Either one of the two metal fasteners illustrated below will give very satisfactory service to users who prefer this method of joining belts. Both of these fasteners are strong and durable, and, when properly applied, will hold securely throughout the life of the belt. The manner of attaching is simple, and takes but a very short time.

Before joining, a belt should be one-eighth to one-quarter of an inch shorter—according to size of belt—for every foot in length than the actual distance between and around the pulleys. It is important also that that the ends of the belt be cut absolutely square.



On the left, a method of belt lacing. On the right, two styles of metal fasteners.

Extension to Plant at Galt, Ont.

The Canada Machinery Corporation will erect a steel and brick extension to their plant on Water Street South, Galt, Ont. In view of the present high cost of structural material the company are utilizing the building owned by them in Hamilton, and this structure is being dismantled and re-erected in Galt. This extension will give the company about 24,000 square feet and additional floor space, and will give employment to one hundred additional workmen.

Special facilities are announced officially for week-end cable letters at cheap rates to or from Canadian soldiers, sailors, and nurses on overseas service. The letters must be of a social character and can be cabled at 5 cents a word to or from Ontario.

Lump Sum and Cost Plus Contracts

A Summary of Arguments Pro and Con from Viewpoints of Contractor, Engineer and Owner

AN excellent summary of arguments, pro and con, relative to the "cost plus" form of contract was given by Mr. Fred A. Jones, president of the Fred A. Jones Construction Company, Dallas, Texas, in a paper presented before a state meeting of the American Society of Civil Engineers. An abstract of the paper, as given in Engineering and Contracting, follows:

Unless a close analysis, based on actual experience, is made, the old style "lump sum" or "spotter" method of contracting apparently has a great many advantages.

It is generally thought that the "lump sum" contract is a protection against graft, and especially in public work, due to the publicity given to the lettings, and because of the stringent clauses in the contract or specifications by which the architect or engineer becomes a representative of the owner, and closely watches to see that the contract is performed in all respects. Another supposed advantage is in the idea that the exact cost can be determined better in advance than by estimating, and, further, the "lump sum" form of contracting enables the owner to avoid the embarrassment of selecting one contractor from among several, which at times, due to friendships or business reasons, might be awkward.

The Contractor's Viewpoint

From the contractor's viewpoint there is a general feeling that more money can be made out of "lump sum" work than under the "cost plus" method, and the average contractor likes the gamble, because all savings that can be effected are his, adding just that much to his profits, whether these savings are effected by actual economy in operation, change of the market condition, change of plans (which usually brings added profits), or by obtaining especially good treatment from the inspectors.

While the "lump sum" contract undoubtedly causes more trouble and work and expense for the consulting engineer or architect, yet he is apparently willing to undergo this on account of the apparent added importance to his position. This is more especially true of the narrow-minded or inexperienced engineers or architects, but there are really big men, with ability, who still have the desire to put the contractor in a position of being obliged to cater to the owner's representative and his fancies.

The objections to the "lump sum" contract from the contractor's point of view are not, as commonly supposed, due to hazards, because the hazards can be reduced to a minimum, if the contactor has ample capital, a good organization, and never submits proposals without having a double-checked estimate, with a reasonable margin of profit. I mean by a double-checked estimate two separate and independent estimates made by two estimators, and handed to the construction manager, who compares them and makes up his cost figures from his experience and the two independent estimates. Of course, the contractor should be able to use good judgment in the selection of architects, engineers, and owners, with whom he figures, because it is very easy for unfairness on the part of those with whom he deals to cause him large losses; but the only real hazards, other than poor management, are the elements, unscrupulous or careless bidding of competitors and unfairness of architects, engineers, or owners.

General Contractor Responsible for Failures of Sub-Contractors

There is another hazard that can be reduced to a minimum by good judgment, and that is in the letting of sub-contracts, for it must be remembered that even though a sub-contractor has furnished a good and adequate bond, yet if the sub-contractor fails the owner is looking to the general contractor entirely, with probably a penalty for delay in completion. The general contractor cannot call on the bondsmen of the sub-contractor until he can show a loss and the amount of the loss, which can only be done at the completion of the job; when the time arrives to show the loss and collect from the bonding company you very seldom collect any money on a bond of this character, for, in the desire to rush work to completion, more money will be paid to the sub-contractor than is due him, or the bond violated in some other way.

A serious objection from the contracor's point of view to "lump sum" contracting is that no matter how much time and money he has spent on his organization he is usually classed with any other contractor who can furnish satisfactory bonds. This is due to the lack of appreciation by the average layman of the fact that there can be a very material difference in the structure when completed, as between two different contractors, in spite of all reasonable inspection, although apparently the plans and specifications have been complied with in both cases. This lack of knowledge and experience on the part of the average layman makes it possible for bids to be received, at times, from those incompetent to do the work in hand. Naturally it frequently happens that a good job is spoiled for a good contractor by unintelligent bidding of others, and is spoiled for the owner because he does not receive that for which he pays, and, in addition frequently has lawsuits and other troubles in connection with his work. But this is not the most serious objection.

Few Contracting Firms Get Good Rating

There have been so many chances taken in the past, and so much "rule of thumb" method used in estimating, together with real and unavoidable losses, due to "acts of God" or other causes beyond the control of the contractor, that very few contracting concerns really have a good standing with the banks. Lack of sufficient funds, by reason of this poor standing, frequently causes a loss in what should be a profitable contract. It is impossible for banks to check an estimate and determine whether at the end of a job the contractor will show a gain or a loss in assets, and they are likely to withdraw credit at a critical time. In addition to this, if a contractor is bidding on all the work in his line which comes up in a certain territory, he is not likely to receive more than one out of fifteen jobs bid upon, and the cost of estimating becomes a very large part of his overhead expense, as it is hardly possible to estimate, for example, a $300,000 job at a cost of less than $500. The only estimate by any bidder that does anyone any good is that of the successful bidder; the balance of the money spent by other contractors on estimating is an economic waste. You can be very sure that the "lump sum" contractor does not forget this when he estimates his cost of a job or if he fails to include it he does not know his own cost), and the owner pays in the end; for, like railroads, contractors are not Santa Clauses, and, like other men, they have a feeling that no one is entitled to something for nothing.

From the viewpoint of the consulting engineer or architect there are some real objections to "lump sum" contracting, for in the first place he increases his cost of supervision, which could be avoided by doing the work on a "cost plus" basis, and this is an economic waste. Furthermore, he is forced to look upon suggestions made by the contractor with a certain amount of suspicion, and the natural thought is, "What advantage would the contractor making the suggestion obtain?" In this way he loses a great deal of valuable assistance, because, even though he had confidence in the contractor, the owner, his client, might lose confidence in his expert advice if he were taking suggestions or receiving advice from one whose contractual relations were directly opposed to the interests of the owner. Again, contractors have been known to have some secret understanding among themselves, for this is sometimes done in spite of legislation against such practice. The modern first-class constructing and engineering organizations are the greatest enemies to "pooling" and the greatest friends to "cost plus" contracting.

Organization Cannot Be Selected

Another natural objection of the architect or engineer is that he is not allowed to select an organization which, to his mind, is the most efficient and can lend him most assistance, having some expert departments which he cannot afford to maintain. He must decide who the contractor shall be according to cold figures, knowing frequently in his own heart that it is not the best for the owner to accept the lowest bid, but fearing suspicion of the owner that he has ulterior motives if he recommends so highly some particular organization. In addition to this, in "lump sum" contracting there can be very little reciprocity as between engineer or architect and contractor. There is always a certain amount of give and take in any well-conducted contract, but there exists no opportunity for the contractor to bring to the engineer or architect a commission for professional services by reason of his influence with some particular client, or for the reverse, the architect or engineer to turn over without competition a job for which a certain construction organization is particularly well equipped.

From the owner's viewpoint there are many objections to "lump sum" contracting, some of which have already been covered. In the first place, the contractor and the owner are not working along parallel lines. Their interests are not the same, and this cannot give the best results, though the contractor be ever so conscientious. Most all the objections already mentioned, of his engineer or his architect, would apply so far as the owner is concerned, because of conflicting interests, but if such a contract were entered into as to allow him to select a highly-developed and flexible construction organization, and encourage the most effective use of such an organization, all parties would be working toward a common end. Other objections of the owner are that if the architect or engineer makes any mistakes, thereby causing extras, or, for any other reason, changes should be made, it is not to the interests of the contractor to call attention to these in advance of signing the contract, but rather to await such a time as the owner would be obliged to pay him almost his own price. Of course, any small changes can be covered by a clause in the specifications, but it is impossible to cover any very large change in original plans. The owner dares not pay the contractor more than is due, according to his contract, even though he may know that he cannot get efficient service without the contractor having ample funds, for he might in this way vitiate the contractor's bond. In fact, the whole proceeding must be bound around with a large amount of red tape.

The Cost Plus System

How much better, how much simpler, and how infinitely more to be desired is a form of contract where the contractor, owner, and expert are working in absolute harmony? Under such a contract, harmony exists because their interests are the same, and they practically form a partnership for a time. The "cost plus" contractor receives the wages of trust, and it goes without saying that there must be absolute integrity and efficiency in the organization before it is wise to deal with a contractor on any basis; but, being first satisfied with the contractor's organization and character, the advantages of the "cost plus" method are:

First, the rate of profit being fixed in advance, the owner and contractor are in position to work together for the very best results for the money to be spent. Their interests do not conflict.

Second, desirable changes that arise during construction (and some always arise) can be made in exact equity to the owner.

Third, it should give an owner a better property—the best he and his engineer or architect and contractor can produce for the money spent, at a lower profit than he would usually pay on a flat sum basis—anyway, not exceeding cost, plus a reasonable pre-agreed profit, which is as cheap as he is entitled to it; and,

Fourth, the work can be started immediately without waiting for completion of plans in all their details.

A Better Guide to the Cost

In a "cost plus" contract the owner also receives the savings made in purchases, which are effected by studying conditions as requirements arise for materials, and here is opportunity for considerable saving, sometimes equalling in amount the entire fee of the contractor.

A reliable estimate of the eventual construction cost made by a well organized and experienced contracting concern is a better guide for the owner, as a rule, than the bidder's figures on a "lump sum" contract letting. One of the most satisfactory methods of limiting the cost is to let all parties know in advance this limit and work in unison not to exceed it, but to get the most for the money spent, while to try to limit the cost by requiring a guaranteed maximum is only getting back to the red tape of the "lump sum" contract without gaining anything.

In conclusion, a "cost plus" contract is a bankable piece of paper.

The Canadian National Clay Products Association will hold their annual convention at the Prince George Hotel, Toronto, Tuesday, Wednesday, and Thursday, January 29, 30, and 31, 1918.

The Ontario Department of Highways has just published the proceedings of the Fifteenth Annual Meeting of the Ontario Good Roads Association, held in Toronto, on February 27 to March 1, 1917.

Cold Weather Construction of Concrete Roads

WITH the approach of the winter season road-builders will be interested in methods which will enable them to secure good results in the construction of concrete roads, although the temperature may at times fall below the freezing point.

From the nature of the work it probably will seldom be found feasible to proceed with concrete road-building when the thermometer stands well below the freezing point for long periods of time. The difficulties encountered with water supply and aggregates, forming the subgrade, etc., as well as the danger from frozen concrete tends to discourage road work during such seasons. However, it frequently happens that contractors find it desirable to continue road-building for a few days in the late fall or early winter when freezing temperatures may be expected for a few hours each day. The Concrete Highway Magazine, published by the Portland Cement Association, gives suggestions, prepared by Professor Duff A. Abrams, regarding the proper procedure to follow.

Experience and tests have shown that concrete may safely withstand a single freeze, but will probably be injured if subjected to repeated freezing and thawing before it has thoroughly hardened.

Tests made in the Structural Materials Research Laboratory at the Lewis Institute, Chicago, show that the time of setting of cement is greatly prolonged if the tests are made at low temperatures. It is for this reason that standard methods for determining time of setting of cement require that the tests be made as nearly as practicable at 70 degrees F. Slow setting and hardening of cement is indicated by the low strength of concrete, which, immediately after laying, has been exposed to temperatures near the freezing point.

Strength of Concrete Affected by Temperature

The effect of temperature on the strength of concrete has formed the subject-matter of a number of experimental investigations. One of the most comprehensive series of tests of this kind which has come to the writer's attention was that carried out under the direction of Professor A. B. McDaniels, of the University of Illinois. Compression tests were made on 8 x 16 in. concrete cylinders which had been stored for periods of 3 to 28 days at temperatures ranging from 26 to 91 degrees F. A summary of the principal results of this investigation is given in the diagram. The diagram is reproduced from Bulletin 81 of the University of Illinois Engineering Experiment Station. The values have been reduced to the relative strength of concrete as compared with the strength of similar specimens stored for 28 days at 70 degrees F. It will be noted that there is a pronounced increase in strength with the age of the concrete and with the storage temperature. At temperatures near the freezing point the strength of the concrete is only about one-half that found under similar conditions at 70 degrees F.

Combating Injurious Effects

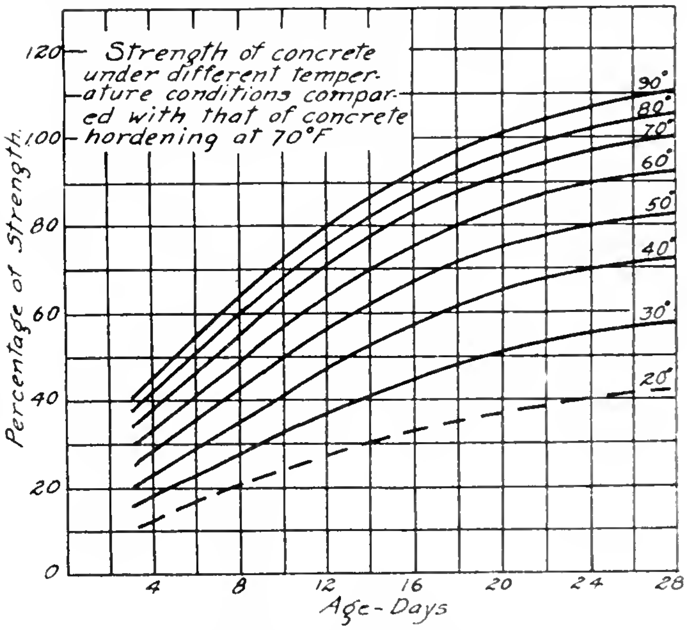
Methods to be followed in combating injurious effects of cold weather in concrete road work may be grouped under the following headings:

A. Precautions which at all temperatures are known to be conducive to concrete of high strength. (Sufficient cement; clean, properly graded aggregate; smallest practicable quantity of mixing water; sufficient mixing; proper finishing methods; prevention of early drying out; sufficient protection from traffic.)

B. Application of artificial heat to materials or finished work, and means of preventing the dissipation of heat developed during setting and hardening of the concrete. (Heating of water or aggregates; heating fresh concrete by steam lines; the use of covering, etc.)

C. Use of chemical compounds which will lower freezing point of mixing water, or accelerate the setting and hardening of the cement.

In the case of concrete road work done in cold weather it is essential that the concrete be given every possible advantage in gaining strength at an early period in order that it may safely resist the destructive action of freezing temperatures. Dirty aggregates,



Effect of temperature on strength of concrete

and especially aggregates containing organic impurities, are certain to cause trouble in cold-weather concreting, due to the slow-setting and weak concrete produced by such materials. Too much water causes a great loss in the strength of the concrete, prolongs the time required for hardening, and furnishes a surplus of the very element which is responsible for cold-weather troubles.

Heating of Constituents

Special care must be taken to avoid the use of lumps of frozen aggregate. Attention is generally called to this point in specifications. On account of frequent moving of equipment, heating of the aggregates is not always practicable in road work, although this is readily done in other kinds of concrete construction. However, if a road roller or other source of steam supply is available, aggregate piles may be heated by inserting pipes carrying live steam. Such heating will be greatly facilitated by covering the piles with canvas.

Valuable results can be attained at little expense by heating the mixing water. This can best be accomplished by inserting an improvised steam coil in the water line near the mixer. The water coil may be heated by a coal or wood fire. It is not necessary that the water be extremely hot; it will accomplish a useful purpose if this method serves only to remove the chill from the aggregate and impart some heat to the fresh concrete.

When there are indications of the temperature falling below the freezing point during the few hours following the placing of the concrete, it is important that the heat generated by the chemical reactions which accompany the setting and hardening of the concrete be retained. This may be accomplished by placing a covering of canvas or other material over the newly-laid road in such a manner as to leave an air space above the concrete. Disturbance of the enclosed air should be prevented as much as possible by weighting the canvas with timbers, sand, or earth.

In the event of an extreme drop in temperature, pipe lines supplied with live steam may be carried under the canvas to protect the fresh concrete from freezing. If the concrete is partially hardened, protection may be provided with a covering of straw or manure. Manure should not be placed in direct contact with the road surface on account of possible injurious effects on the fresh concrete and unsightly discolorations which may result.

The comparatively low strength of concrete exposed to cold weather indicates the importance of taking precautions to exclude traffic for a longer period of time from concrete r . is finished at low temperatures. In estimating the time during which traffic should be excluded it is good practice to disregard each day during which the thermometer falls below the freezing point.

Chemical Compounds

Of the chemical compounds which have been used in cold-weather concrete work, calcium chloride and common salt (sodium chloride) probably give the best results. Calcium chloride possesses the property of lowering the freezing point of water and accelerating the setting of cement, as well as causing the generation of a large quantity of heat, due to the chemical reactions which occur. Tests made in the laboratory show that calcium chloride in small quantities does not cause appreciable reduction in the strength of concrete, nor does it cause corrosion of the reinforcing steel. This compound is generally sold in the crystal form. It is readily soluble in water. If used in quantities of about 3 per cent. by weight of mixing water it will enable concrete to be placed with the temperature several degrees below freezing, with little danger of injury. It can best be added to the mix by making a solution having a concentration of 1½ pounds of calcium chloride per gallon of water. This may be kept in a barrel near the mixer. Add one gallon of solution for each sack of cement used. For the usual 1:2:3 mix this corresponds closely to 3 per cent. of the total mixing water. The use of this material will add about 3 cents per square yard to the cost of the concrete.

Common salt is effective in lowering the freezing point of water, but does not compare favorably with calcium chloride in other respects. When used in quantities of about 5 per cent. by weight of mixing water it has been found effective in preventing freezing at temperatures not lower than 28 degrees F. Its low cost is its principal advantage. Many of the proprietary "anti-freezing" compounds have common salt as a base, with small percentages of other salts, added apparently for the purpose of disguising their real constitution.

It is the writer's belief that the precautions to be observed in cold-weather road work should be considered in the order mentioned above. Special measures should be adopted only after all ordinary precautions are in effect. Heating of mixing water should not be relied upon to counteract the ill effects of dirty or poorly-graded aggregate, or an over-dose of water in the batch. Generallly the heating of concrete materials and protection of fresh concrete will be found most satisfactory. It is not usually desirable to rely solely upon the use of chemical compounds to prevent freezing of concrete. Chemical compounds should be used only in conjunction with other measures described.

Electricity Promotes Economy in Street Refuse Disposal

To gather, remove, and dispose of the street dirt, ashes, garbage, and miscellaneous refuse of a large city is a very important problem. In New York, according to the Electrical Review, it has been attacked with considerable success. In recent years the use of motorized equipment by the Department of Street Cleaning of the City of New York has resulted in important economies, a brief account of which should prove of interest.

Motorized Equipment

The first step taken in rehabilitating what is known as the Model District was to devise plans and apparatus operated by motor power to displace the horse-drawn vehicles and cleaning by hand, so far as practicable. After thoroughly investigating and testing all available apparatus supposedly suitable to the purposes in view, and finding none entirely satisfactory, the engineering division of the department undertook the task of designing the principal pieces of apparatus required for the economical working out of the newly-devised methods. A gasoline-electric tractor was designed by the department's engineering division and, after construction and trial, was found to meet the requirements. At first twelve of these tractors were completed and made ready for service, at a cost of $4,166 each.

Trailers, to be drawn by the tractors, and combining facilities for collecting in separate compartments ashes, street sweepings, garbage, and rubbish, were also designed and constructed. These trailers provide for the collection of the four classes of material on the same trip, whereas the old horse-drawn car requires three distinct trips for the task. In addition to this apparent economy, each trailer carries an amount of waste material equal to eight carloads. Eleven of the trailers were constructed at a cost of $810 each.

Further motorization of the Model District equipment was accomplished by the installation of a combination flusher-sweeper, which was also designed by the department's engineering division. This machine, as its name indicates, flushes and sweeps the street pavement in one operation, thus not only enhancing the quality of those branches of the service, but doing so economically. Three more of these combination machines were then provided for use when weather conditions would permit of flushing. Other equipment in the Model District has been made to conform to the motorized collection methods, for instance installation of locomotive cranes for transferring trailer loads to scows, and advancing all contingent apparatus and methods to the higher plane.

$68,000 Saved

Approximately $68,000 was saved to the city by this modern equipment in 1916, as compared with 1914, the last year in which horses exclusively were used for collection in the district. It was found desirable to motorize other districts, as the Model District fulfilled the promises made for it by the head of this department, and new motorized apparatus is rapidly being introduced to great advantage.

The nuisance occasioned by uncovered carts used in transporting ashes and garbage, which had for a long time been a source of complaint from citizens, was abated to a considerable extent. By employing savings made from the maintenance appropriation, the department was able to provide covers for 400 of the carts the first year, and later the policy of providing covers for carts was continued, until now it may be said that practically all carts used in the collection of ashes or garbage are covered. Covered department cans for street sweepings and other refuse have been placed in districts where they were badly needed.

The extension of street flushing has been a cardinal feature of the administration's program, until practically every street is flushed. The hose gangs were increased and the area flushed and washed was extended until, in the summer and fall months, practically every street in Manhattan, and most of the important or congested thoroughfares in Brooklyn and the Bronx, were cared for by hose, squeegees, or sprinkling carts and machine sweepers at least once in every twenty-four hours.

During the summer and fall of 1916, when infantile paralysis was so prevalent, extra precautions were taken in every direction, and the pavements in the congested sections were flushed frequently, in some instances two or three times during a day, and especial attention was given to those streets in which there were pushcart markets. The combination flusher and sweeper greatly facilitates the work of street washing, and was constructed under department designs.

Montreal-Sherbrooke Road to be Started in Spring

A deputation from the Dominion Good Roads Association and from the Eastern Townships waited on the Hon. J. A. Tessier, Minister of Roads, with a request that work should be commenced on the Montreal-Sherbrooke highway. The Minister promised that this should be done in the spring, provided all the municipalities would get into line. Mr. Tessier also expressed a hope that he will be in a position to make an early start on a road between Sherbrooke and Beauce, forming a connecting link with the Levis-Jackman highway. The Quebec Legislature is to be asked to improve the roads in the Laurentian Mountains.

Canadian Sandstones Suitable for Pulp Grinders

The Mines Branch of the Department of Mines (Canada) has issued a bulletin by L. Heber Cole submitting results of tests of some Canadian sandstones to determine their suitability for use as pulpstones. Heretofore wood pulp grinders have been imported commodities; and, in view of the high prices and possible restrictions on import after the war, the investigation has been conducted to encourage and assist the industry in Canada. In order to obtain comparative results, samples of imported pulpstones, the quality of which was known, were subjected to the same tests as the samples from Canadian sources. The latter compared very favorably with the imported stones, and the results lead one to believe that there are great possibilities for extending the industry in Canada.

New Industry Located in Hamilton

The Industrial Department of the city of Hamilton, Ont., announces that the Robert H. Hassler, Ltd., manufacturers of the famous Hassler shock absorbers for Ford cars, has decided to locate their Canadian factory in Hamilton. The United States factory, which is located in Indianapolis, Ind., is swamped with orders from Canada. Fred Morris, of the F. G. Morris, Ltd., the Canadian distributors of the Hassler shock absorbers, worked hard to have this factory located in Hamilton, and much of the credit of securing it is due to his efforts. A building on Sherman Avenue North has been leased, and operations will be started immediately with a staff of about 25 employees. J. C. Piper will be the managing director of the new company.

Advertising Engineering Education

In the September issue of "Engineering Education," the bulletin of the Society for the Promotion of Engineering Education, it is asserted that many young men would attend institutions of higher learning, and especially engineering schools, if these schools were brought to their attention in a concrete and concise way. Many young men in high schools have no opportunity of becoming familiar with the aims and objects of engineering schools, since most of their instructors, with the possible exception of those who teach manual training and physics, are graduates of colleges of liberal arts and have no conception of the engineering profession. At this time of rapid development in engineering education, it seems especially desirable that the need for engineers should be brought to the attention of the young man by means of the daily papers and the magazines with which he comes in contact.

To Consider Terminal Facilities for Transcontinental Railway at Quebec

The Quebec Board of Trade have requested the Montreal Board of Trade to join in asking the government to appoint a commission of experts, including eminent engineers, to enquire into the question of providing terminal facilities for the Transcontinental Railway at Quebec. It is contended by the Quebec board that unless these facilities, in the way of docks, elevators, etc., are provided, an enormous amount of traffic, especially from the Northwest, will be diverted to United States ports. The Montreal Board of Trade is of opinion that the question must be deferred until after the war.

Company to Build Houses

Compagnie de Construction Ouvrieres Laval, Ltd., has been formed with a capital of $30,000, for the purpose of acquiring land and building dwelling houses of reasonable dimensions to be let at a moderate price; and to carry on the general business of quarry masters and suppliers of stone. Mr. Cyrille Durocher, contractor, of Montreal East, is among those interested.

Practical Hints for the Contractor

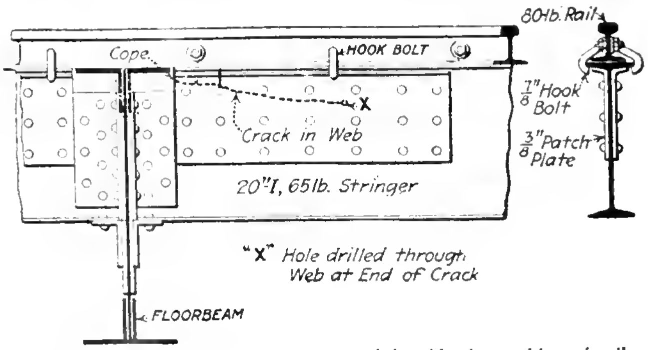
that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Cracks in I-Beam Webs, Caused by Rocking of Rails, Repaired by Patches

HORIZONTAL web cracks developed in more than 200 I-beam track stringers carrying the rails directly over and in line with the stringers for some ore bins in Birmingham, Ala., and were repaired by patches riveted over each crack. The details of the construction and repair are shown in the accompanying drawing. The stringers are 20 in. 65-pound I-beams and carry E-50 loading on the 80-pound rails, which are fastened to the beam by hook bolts placed alternately, as shown.

The crack in each case started at the point of cope and extending from 5 to 30 in. along the beam. The failure is thought to have been caused by the sidewise rocking of the rail and beam flange under passing loads, which produced bending in the web of the beam. The sharp corner cut made in coping furnished the necessary start for the cracks, which traveled almost horizontally along the beam.

As it was not possible in this case to provide other means of supporting the rail on the beam, a small hole was drilled through the web at the end of the crack, to



Long cracks were produced in I-beam web by sidewise rocking of rails.

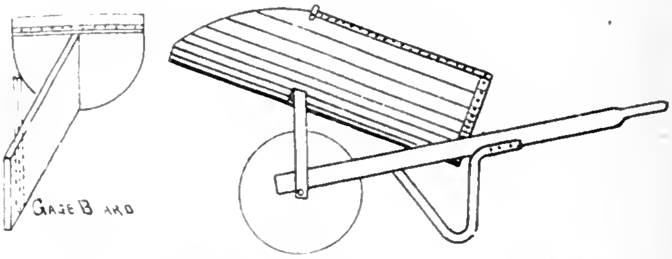
prevent further fracture, and a 3/8 in. plate, bent to fit snugly under and support the flange, was placed on each side of the web, as shown. This method of repair has been proved by many months' service to be satisfactory.

The case is reported in Engineering News-Record by R. E. Parker, structural steel designer, Birmingham.

Home-Made Wheelbarrow That Conveniently Measures Contents

AGGREGATE for concrete used by the Lock Joint Pipe Company, Ampere, N.J., in the construction of large reinforced sewer and water pipes is very conveniently delivered and charged into the mixing machine by special adjustable measuring wheelbarrows, as shown in the illustration, taken from "Contracting."

These wheelbarrows have a substantial home-made wooden frame, supporting an inclined body with the forward end elevated to a height of 30 in. The sheet steel trough-shape body is 17½ in. wide and 13 in. deep, with stiffened upper edges and a closed lower end. The upper end is beveled like a scoop and the



Adjustable gauge board determines volume of sand or gravel.

upper edges are reinforced and are tied together at the top of the bevel by a horizontal transverse piece that serves also as a stop for the gauge board.

The amount of sand or gravel carried is determined by means of a vertical transverse wooden gauge board having the same cross-section as the sheet iron body. It is stiffened by a long, full depth vertical longitudinal web. This web is narrow enough to pass under the transverse stop on the body, and to it there is attached, wherever required, a vertical bar projecting above the upper edge of the web, so as to engage the transverse stop. By setting this vertical piece in different positions any required volume within the capacity of the body may be provided for in front of the gauge board, which is instantly put in place and removed, allowing the concrete in the barrow to be dumped over the wheel to the charging hopper of the mixer. Such barrows can be easily made in any contractor's yard and would often promote the convenience, rapidity, and accuracy of the work.

New Secretary for American Concrete Institute

Mr. Harold D. Hynds, who has been secretary of the American Concrete Institute for the past two years, has recently enlisted in the engineering arm of the service of the United States. In consequence of this step, his resignation has been tendered and accepted. Mr. Henry B. Alvord, who has been administrative assistant for the past nine months, will replace Mr. Hynds as secretary.

In the past twelve months the institute has published Volumes IX., X., XII., and XIII., which bring the publications fully up to date. Under the management of President W. K. Hatt and the Board of Direction, the institute is making a very creditable showing in the work which it is doing in its own field. Over one hundred names have been added to the membership list in the past twelve months; the technical committees are actively at work, and from present indications a very successful convention is anticipated. This will be held next February 7, 8, and 9, at Hotel LaSalle, Chicago.

Will Commemorate Completion of Quebec Bridge

Acting on the suggestion of the president of the Canadian Society of Civil Engineers, the council have decided to place, in headquarters, Montreal, a brass tablet commemorating the completion of the Quebec Bridge. A committee has been appointed to make suggestions for a suitable design and inscription.

Bridge Company Making Marine Boilers

The Dominion Bridge Company are now engaged in the manufacture of marine boilers, and are carrying out a large contract for one of the allied governments. The company will also manufacture turbines for steam power plants. The company have obtained a controlling interest in the International Engineering Works, Ltd., of Montreal and Amherst, N.S., and will carry on the business as a subsidiary.

Mainly Constructional

East and West—From Coast to Coast

A by-law will be submitted to the ratepayers of St. John's, Nfld., in December, to authorize the raising of $40,000 to build a concrete sewer.

Four bents of the P. G. E. trestle bridge over the Capilano River in the North Vancouver district, were washed out or damaged recently by high water.

Some trouble has been experienced with the purification of the water supply of Chatham, Ont. To remedy conditions, it is suggested that the sedimentation basin at the waterworks plant be enlarged to three times its present capacity.

The International Molybdenum Company, now located at Orillia, Ont., will shortly transfer their furnaces to Renfrew where they will use a large block of power obtained from the Calabogie Light and Power Company's development.

The new steel bridge over the Petitcodiac River at Moncton, N.B., is just about completed. As the weather is too cold for the pouring of concrete, plank flooring is being laid on the last span to carry traffic until next spring. On the previously erected spans the flooring has all been constructed.

A recommendation has been made by the Dominion Railway Board that the G. T. R. submit plans of a subway to be constructed at their Yonge street crossing a mile and a half north of Aurora, Ont. If a subway is built the cost will be borne jointly by the railway and the municipalities of King and Whitchurch.

Residents of Slocan City, B.C., are agitating for the establishment of a telephone connection between Slocan City and Nelson. At present the B. C. Telephone lines run only to Slocan Junction, a distance of 28 miles from Slocan City. The construction work between these two points is considered extremely costly and difficult, according to telephone officials.

During the month of November, building work in Halifax, N.S., is reported to have lessened considerably with the approach of the cold weather. Work has been continued on the erection of the annex hospital building on Camp Hill. The foundation for the new G. T. R. freight shed on the old Cunard wharf property has also been proceeded with, but the building to be erected upon it this season is only to be of a temporary nature. A new telephone building on Sackville Street has recently been completed and a number of contracts for residential work has been let.

Mr. W. A. McLean, Deputy Minister of Public Highways for the Province of Ontario, recently addressed a joint meeting of the councils of Oxford County, the town of Ingersoll and the city of Woodstock, describing for them the working of the Suburban Roads Act under which it is proposed to carry out some highway improvement work. The Ingersoll delegation expressed the opinion that the road from Woodstock to Ingersoll should be the first piece of roadway to be put into shape under the new scheme, and it was suggested that a permanent concrete pavement should be constructed to take the place of the present very unsatisfactory thoroughfare. No definite action was decided upon but the general opinion appeared to be in favor of carrying out this suggestion as soon as conditions would permit.

The preliminary work has been got well under way and excellent progress is now being made on the Chippewa hydro-electric power canal. The construction railway which will carry away the material excavated has been completed from the Whirlpool to the power-house, and the rest of the line is being pushed forward. The Hydro engineers were handicapped by shortage of labor, but now about 350 men are employed, and unless the weather gets too severe this gang is expected to remain. All the Chinese have been got rid of, as they did not seem to make good on the heavy work. At the present time operations are being centered on the erection of a concrete bridge for the Niagara, St. Catharines & Toronto Railway tracks at Stamford. This is only one of about thirty bridges which will have to be built. The engineers are filling in a great many ravines around the Niagara River with the earth taken out in excavating the canal.

On November 24, the Toronto-Hamilton Highway was formally opened by Sir William Hearst, Premier of Ontario. A large gathering of representatives of the commission, the provincial government, the local municipal councils and the Ontario Motor League was present, and after the ceremony the party motored over the new road to Hamilton, where a luncheon was held in the Royal Connaught Hotel. Premier Hearst gave an address in which he complimented the members of the highway commission on the untiring energy which they had displayed. He also referred to the plans projected by the Ontario government for the construction of highways and said that while every man and every dollar must be used to win the war, when hostilities ceased the province would undertake a large programme of road building. Mr. Edwin Duffy, commissioner of highways, New York State, was the guest at the luncheon. Mr. Duffy, in an address, paid high compliments to Canada's patriotism. With reference to the highway, he said it was the best road known to modern construction. Four presentations were made at the close of the luncheon. Canes were presented to Sir William Hearst and Hon. F. G. Macdiarmid, Minister of Public Works, while Mr. Geo. H. Gooderham received a handsome club bag from his colleagues of the Highway Board, and Mr W. D. Flatt, a silver loving cup.

Personal

Sapper R. G. Patterson, a 1914 graduate of the Faculty of Applied Science and Engineering of the University of Toronto, is reported wounded and gassed. His home is in St. Mary's, Ont., and he was attached to the 4th Division signalling company of the Canadian Engineers.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Chatham, Ont.
City Council contemplate construction of drainage system on Pine Street. Engineer, J. Adams..

City Council contemplate construction of a glazed tile sewer on Park Ave. Engineer, J. Adams.

Railroads, Bridges and Wharves

Amherst, N.S.
Board of Trade are contemplating approaching the Canadian Government Railways and municipalities to erect a subway under Canadian Government Railway crossing at Erncliffe St.

British Columbia, Province of.
Tenders received by the Minister of Works, J. E. Griffith, Victoria, until noon, Dec. 10, for the erection of a bridge over the Sooke River for the Department of Public Works, Provincial Government.

Vancouver, B.C.
J. Coughlan & Sons, 500 Beatty St., are having plans prepared for wharf and four launching ways which they will construct at False Creek.

Public Buildings, Churches and Schools

Kindersley, Sask.
By-law will be submitted for a $50,000 union hospital.

New Glasgow, N.S.
The Masonic lodge contemplate the erection of a hall, costing about $30,000. Committee, J. Ed. McDonald and J. R. Murray.

Prince Albert, Sask.
The Military Hospital Commission, 22 Vittoria St., Ottawa, will convert plant into tuberculosis hospital. Officer in charge, W. L. Symons, Ottawa.

Regina, Sask.
The Regina College, Sixteenth Street, contemplate the erection of an addition. President and principal, E. W. Stapleford, B.A., D.D.

St. John, N.B.
Tenders being received by Capt. Symons until Dec. 8 for the erection of an addition to county hospital, nurses' home, etc., for the Military Hospital Commission, 22 Vittoria St., Ottawa.

The Tabernacle Baptist congregation contemplate the erection of a church. Pastor, Rev. F. P. Dennison, Haymarket Square.

Plans and specifications with the Military Hospital Commission, 22 Vittoria St., Ottawa, who will receive tenders until about Dec. 22 for the erection of a tuberculosis hospital.

Toronto, Ont.
Tenders received until Dec. 13 for the erection of a $75,000 school annex at Queen Alexandra School for the Board of Education.

Vancouver, B.C.
Rotary Club of Vancouver, Vancouver Hotel, contemplate the erection of a tuberculosis hospital.

CONTRACTS AWARDED

Fort William, Ont.
Mahon Brothers, Victoria Ave., have the electrical contract for $17,500 brick church for the Ruthenian congregation.

Lachine, Que.
Fournier Brothers have the general contract and will let sub-contracts for the erection of a $70,500 school for the school commissioners, Tres Saint Sacrament.

Lanoraie, Que.
The following contracts have been awarded in connection with the erection of a $55,000 church for the parish: Steel, Phoenix Bridge and Iron Works, Ltd., 83 Colborne St., Montreal; roofing, F. Paquette & Co., 112 Montcalm St., Montreal; painting, T. X. Renaud, 2312 Esplanade Ave., Montreal; electrical work, J. A. St. Amour, 2171 St. Dennis St. The general contractor, L. J. Fauteux, St. Benoit, will carry out the masonry, carpentry, and plastering.

Montreal, Que.
L. Roger, 760 St. Andre St., has the painting contract for $75,000 addition to building for the Provincial Government, Quebec.

Point Grey, B.C.
Layfield & Tardiff, 1024 Broadway St. W., Vancouver, have the general contract for cottages, addition to dairy building, etc., costing $25,000 for the University of British Columbia, Eleventh and Willow Streets, Vancouver.

Regina, Sask.
Wilson & Wilson, 1017 McCallum Hill Building, have the general contract for alterations to bank for post-office for the Department of Public Works, Dominion Government.

St. Hubert, Que.
F. Masse has the general contract for three schools, costing $3,000, for the school commissioners.

Three Rivers, Que.
The J. T. Schell Company, Kenyon St., Alexandria, have the general contract for post-office, customs, and inland revenue fittings for the Department of Public Works, Dominion Government.

Toronto, Ont.
The following contracts have been awarded in connection with the erection of a $90,000 school annex on Perth Avenue for the Board of Education: Masonry, H. Lucas & Son, 141 Havelock St.; reinforced concrete, Concrete Construction Company, 330 Broadview Ave.; carpentry, F. Armstrong, 89 Oak St.; terrazzo, Italian Mosaic and Tile Company, 429 Spadina Ave.; plastering, Petrie & Son, 495 Dupont St.; roofing, A. Matthews, Ltd., 256 Adelaide St. W.; painting, J. Phinnemore, 367 Dupont St.; electric wiring, Canada Electric Company, 183 Church St.; plumbing and heating, Purdy, Mansell, Ltd., 63 Albert St.; heat regulators, Johnson Temperature Regulating Company of Canada, Ltd., 118 Adelaide W.

Business Buildings and Industrial Plants

Amherst, N.S.
Tenders will likely be called in a few days for erection of an addition to moulding shop for the International Engineering Company.

Halifax, N.S.
Tenders will be called shortly for the erection of a reinforced concrete garage for Clayton & Sons, corner Jacob and Barrington Streets. Architect, Sydney P. Dumaresq, St. Paul Building.

Levis, Que.
Kleker, Bernard & Co., Ltd., 1855 Papineau Ave., Montreal, contemplate the erection of an abattoir.

Ottawa, Ont.
Millson & Burgess, Union Bank Building, are preparing plans for warehouse to be erected on Redpath St., for A. L. Florence, Redpath St.

Oxford, N.S.
Wood and Thompson will make alterations to printing office for warehouse.

Pembroke, Ont.
The Colonial Lumber Company will rebuild mill which was recently destroyed by fire.

Port Arthur, Ont.
The Canadian Northern Railway, head office Toronto, will reconstruct grain elevator, at a cost of $500,000.

The Saskatchewan Co-operative Elevator Company, Grain Exchange Building, Winnipeg, will erect a $450,000 grain elevator.

Port Clements, B.C.
The Graham Island Spruce and Cedar Company, head office, Prince Rupert, are having plans prepared for sawmill, wharf, etc.

Shelburne, N.S.
Frank J. Carter, Sturdee Hotel, Dartmouth, contemplates the erection of a cold storage plant.

St. John, N.B.
The Small Estate will rebuild, at a cost of $20,000, business block on Dock St. which was recently destroyed by fire.

St. John's, Nfld.
The Marine and Stationary Engine

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Principal Contents

Quebec Will Check Municipal Expenditure

"OWING to the increase in the operations of public corporations, it has become necessary to create a special branch of municipal affairs, and a bill to that effect will be submitted to you."

This is a clause from the Speech from the Throne delivered at the opening of the Quebec Legislature, and announces legislation which has been repeatedly urged upon the government, and which has been made imperative by the extravagance of municipalities, of which Montreal is a conspicuous example in the province. Municipalities throughout the Dominion have in too many instances outrun the constable, and have lavished money on projects, some of a very useful character, which are years ahead of real requirements. This refers particularly to the West, due to the land boom, but the East has not been free from an optimism which has led to financial embarrassments. In other cases, such as the Montreal aqueduct, expenditure has been undertaken without proper consideration and money has been spent as if there were a never-ending supply. The war has merely accentuated some of the difficulties which would have followed in any case the lavish programmes, and it is to the credit of many municipalities that at the beginning of the war they shut down at once on further outlay on those improvements which can wait.

The Quebec Government, it is learned, propose to establish machinery for checking expenditure, and keeping municipalities from running so freely into debt. There can be no doubt as to the absolute necessity of this—for the credit of some municipalities is getting dangerously near the vanishing point. The ratepayers have at present practically no control over the money spent—and although they can reject members of municipalities at the annual election, experience shows that too often others returned on an economy ticket are just as bad as those who were rejected.

The English system of checking expenditure, while it may not be entirely suitable for Canada, has some good points. The expenditure is subject to the consent of the Local Government Board. For instance, if a municipality desires to carry out a drainage scheme or even spend, say, $3,000 on a motor truck, the sanction of the Local Government Board must be obtained, and before this is given an inspector of the Department holds an inquiry as to the necessity of the scheme or expenditure and the financial standing of the municipality, and sometimes consent is refused. The annual expenditure is also checked by an auditor of the Department and if the members have spent money in an unauthorized direction, they are liable to be personally surcharged—a method which ensures that members will be very careful of the way in which they lay out the ratepayers' money.

The Power Situation

CONSERVATION of our natural resources is an important policy at this time of national stress, when production is the keynote of our actions. All our efforts at producing in ever increasing quantity those materials that are most required in the war, depend ultimately upon conservation. On this account, therefore, the annual meeting of the Commission of Conservation held recently at Ottawa has, at this particular time, an influential bearing that is hard to overestimate.

Inseparably tied up with production is that factor—power—on which it is absolutely dependent. Power is the root-basis of all production, so essentially basic, indeed, as to be the very life of industry. The importance of power and the power situation in Canada is reflected in the work which the Conservation Commission is performing. The peculiar position of this country in respect to its power resources has been the subject of much study on the part of the Commission, and at the annual meeting, a resume of the situation was presented in one of the most important papers of the programme, by Arthur V. White, consulting engineer to the Commission. This paper emphasized the paramount importance of conserving for use in Canada every unit of power that belongs to us.

This country at this time, occupies a position in respect to power that is more or less of a predicament and which requires diplomatic and yet no uncertain solution. Consider in the first place that great source of energy—coal.

To begin with, our best quality coal upon which so many of our communities are now dependent, comes from outside of Canada; even to-day we are feeling the significance of this. Even in many places in New York State there is a present shortage, and with the most friendly relations existing between the two countries we must realize the justice of the old saying that charity begins at home. If Ontario is now pinched for fuel what might the situation become if the United States found it necessary to seriously curtail export or if for any reason the friendliness of the United States denied us in this matter?

That seems to throw us back on our own resources, therefore—our water powers; and what is the situation? To-day Ontario especially is crying out for more electric power; established industries are being curtailed in their supplies; the load is being jockeyed at the peak period to enable the essentials to carry on, and the general public is being importuned to economize and turn off, where possible, even a light or two.

The Commission of Conservation has this very matter in hand. Time and again in recent years the attention of the public has been directed to the imminence of a condition that the war has simply hastened. Most of us were taught, in the early days, that the water powers of Canada existed in such abundance that their value was questionable and their conservation unnecessary. How foolish and narrow this viewpoint was we are now realizing, when we have it thrust upon us that our commercial stability and expansion depend upon whether we can get more power.

This is the issue, then, that is considered in Mr. White's paper, and which is of vital concern to every citizen of the Dominion—the paramount importance of conserving, for use in Canada, every single unit that belongs to us, either for direct use of Canadian citizens or, it may be, for exchange on an equitable basis for coal or other commodities which may be indispensible to Canada at some future date.

Arbitrate Montreal Aqueduct Controversy

ANOTHER development has taken place in the contract for the construction of the Montreal aqueduct, which has been the subject of wide controversy, particularly in regard to the hydro-electric section, designed to give power for pumping and lighting purposes. The city has spent tens of thousands of dollars on reports and plans, the scheme having been enlarged from time to time. It has, however, been vigorously criticized by eminent Montreal engineers as uneconomical and wasteful. The Board of Control have now decided to cancel the contract with the Cook Construction Company, leaving the work about half completed. The ground for this action is that the high cost of material and labor does not warrant the work being carried out at the present time. The city and the contractors have agreed to submit their claims and counter-claims to arbitration; Mr. W. F. Tye, M.C.S.C.E., will represent the Cook Construction Company; Mr. J. M. R. Fairbairn, M.C.S.C.E. the city; and Mr. Aime Geoffrein will act as the third arbitrator. The city has agreed to withdraw a counter-claim against the company for $900,000, this being the cost to complete the work if the company abandoned the contract. The company informed the city that unless this claim was waived they would proceed before the courts.

Controller Cote, who has been the most vigorous defender of the scheme, stated that under ordinary circumstances he would never have consented to the cancellation of the contract, but the war affected financial conditions so much it was practically impossible to go on with great public enterprises for a year or two. Moreover, the cash was not available. Further, the city could not keep the company on the job with its plant. There had been many delays and difficulties since 1913, the company claiming it was the city's fault, and the city claiming it was the contractor's. The city, however, would take steps to see that thte city was provided with a proper water supply. It was certain that more water would be required than the conduit would carry, and it was therefore imperative that the city get the water into the open aqueduct to make certain of an adequate supply.

The Duty of Canadian Manufacturers

THE following interesting letter from one of our readers, in response to our request for an expression of opinion on the business outlook of the near future, appears to us to hit the nail pretty squarely on the head. After all, the big thing is that we shall so conduct ourselves to-day, that after the war is over and we all have time to sit down and take an inventory, Canada shall feel no shame and no regret at the course she has followed:—

"There is no cloud on the commercial horizon at present. Of course the future state of business depends largely on the duration of the war and the extent of our participation in it. If we do our duty—and I think we will—we shall put all our resources into winning the war. If we do this it might mean that some now essential industries would have to be re-equipped to take care of essentials.

"I make the prediction that we will all be in government service 'ere long, either serving at the front or at home, that all profits will be cheerfully eliminated in the interest of the state and that we who cannot serve overseas will be serving at home doing the thing we are best qualified for, cutting out luxuries, increasing the supply of, and saving food stuffs and generally equipping ourselves to be worthy of a place in the front of the Empire and worthy of the boys who have given their all for us.

"In keeping the home fires burning, every patriotic manufacturer will keep his business in such flexible position that he can serve the government in such requirements as they may need and at the same time keep his regular line of business organized and alive so that immediately the war is over he may be able to employ the boys who return, in their regular occupation.

"There is need and use at home for every person who is able to work to take the places of those who are to serve in the present draft, and will be so long as we do not show any yellow streaks.

"We need not worry at present about business; all of our concern needs to be whether or not the nerve of Canada is going to match the nerve of our Allies. If it does, Canada will remain on the map as a great nation in the building. If it does not, we will join 'No Man's Land.'"

Concrete Cantilever Arch Bridge on Mount Pleasant Road, Toronto

A Highway and Railway Structure with Earth Fill and Timber Trestle Approaches — Three Small Spans Set on a Skew

ONE of the civic improvements carried out in Toronto, Ont., during the past season has been the Mount Pleasant Road project in the old town of North Toronto, which since its incorporation into the city is still known by the same name. Hitherto; there has been no through street in that district closer than a mile and a quarter to Yonge Street, the city's main thoroughfare. To give the north end of Toronto, therefore, adequate communication service and at the same time relieve Yonge Street of the growing density of traffic, a parallel through street has been advocated, extending from the Moore Park district to the northern city limits. The existing Mount Pleasant Road, located north from Merton Street, about one half mile east of Yonge Street, was chosen as the logical position of the new thoroughfare. To extend this southerly to the Moore Park District and so give outlet to the lower part of the city, required an entirely new street below Merton Street, to the east of Mount Pleasant cemetery. The lay-out of this road, being on fairly level ground, is comparatively simple and the requisite grading has been carried out during the past season.

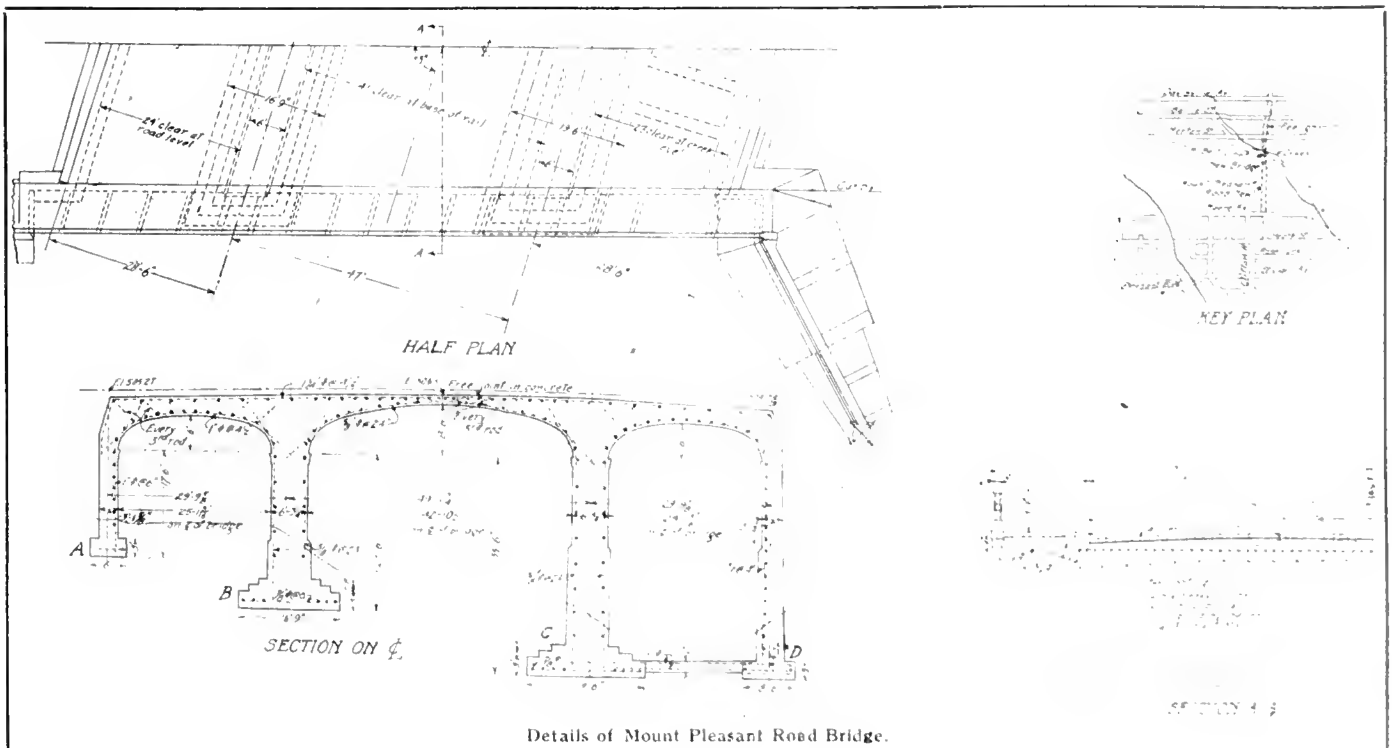
Bridge Over Ravine

The level contour of the road site is broken just south of Merton Street by a shallow ravine through which are located a small creek and the tracks of the old Grand Trunk Belt Line. The maintenance of the railway right-of-way called for a bridge to span the gap, instead of fill as might ordinarily be found satisfactory. This article, in the main, deals with the design and construction of this bridge. In addition to the grading of the new Mount Pleasant Road and the erection of the bridge to span the ravine, the existing Mount Pleasant Road north of Merton Street is being straightened and realigned. Merton Street will also require to be raised at the bridge site, as the new contour of Mount Pleasant Road is about seven feet above Merton Street. The entire improvement is planned for the accommodation of street railway tracks.

The first scheme for bridging the ravine was by a plate girder design with trestle approach on the north. This was rejected in favor of a concrete bridge of the cantilever arch type. This bridge has the distinction of being one of the first of its kind in the vicinity of Toronto. The bridging problem was not unusual, so that in neither design or construction were any unusual features necessary.

The structure has a length of 109 feet, exclusive of the approaches, and consists of a 43 ft. clear span cantilever arch and two 25 ft. clear beam spans. The beam spans are given arch contours. The south approach is an earth fill about 425 feet long and the north approach is a timber trestle 140 feet long. The bridge is 62 feet wide out to out of handrails, with a 46-foot roadway and two sidewalks, each having a clear width of 7 ft. The clearance at the centre is about 22½ feet above the G. T. R. Belt Line tracks.

The south approach is graded on a 3 per cent. up grade approaching the bridge. The north trestle work

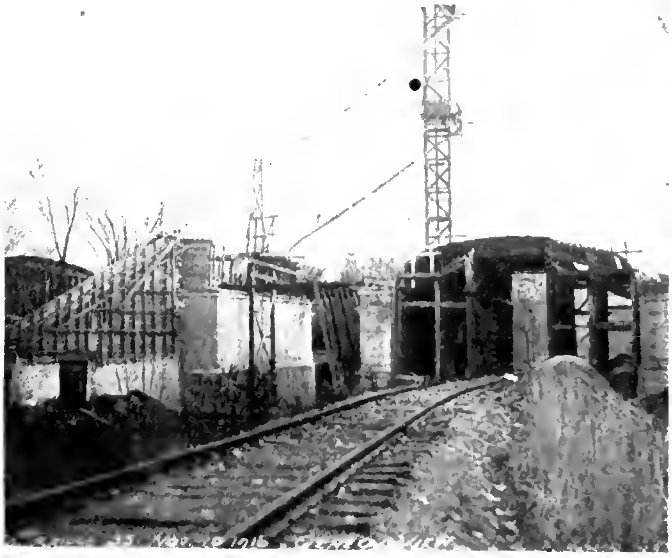


Details of Mount Pleasant Road Bridge.

has a five per cent. grade and the bridge itself has a vertical curve with a rise of over a foot. The trestle approach comprises 11 bents of standard timber construction paired into towers and decked with 3-inch planking and 2-inch wearing surface on 4 x 14 stringers. The bents are framed of eleven 10 x 12 posts on 10 x 12 sills, bearing on concrete pedestals, one for each post. The end posts only are battered 1 in 12. The caps are 12 x 12's and the cross braces 2 x 10's. Two 6-ft. sidewalks with a 46-ft. roadway, including double tracking, are accommodated. This trestle will be filled in with earth fill later when the improvement is more advanced.

The bridge itself, since it is intended to provide for street railway traffic, has been designed according to the standard specifications of the Ontario Railway and Municipal Board.

The entire bridge is set on a skew of 73 degrees to accommodate the present railway track. The abut-

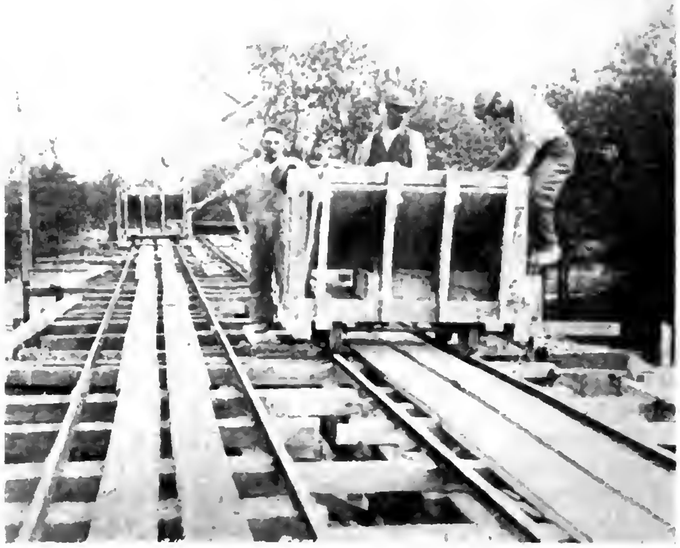


Showing north abutment, piers, falsework for main arch and concreting tower and spouts.

ments are of the buttressed wing-wall type and both piers and abutments have stepped footings on gravelly soil. The south abutment is U-shaped while the north one has flaring wing walls. These are required to hold the fill that will later be placed in the trestle work. The north pier and north abutment are tied at footing level to provide additional resistance against the thrust developed by this fill.

Cantilever Arch Design

The bridge is designed as a cantilever arch, the main arch being formed of two cantilevers from the piers. The other spans, which are of arch contour, are in reality beam spans. The whole structure is, therefore, considered as a continuous beam proposition. To maintain the cantilever action at the centre, a free joint is inserted in the concrete. It is faced with tar paper, and to prevent sag the reinforcing bars of one arm project into the other so as to provide a lock but they are wrapped in tar paper to maintain freedom of action. This joint is the main expansion joint of the structure. The sidewalks are carried on cantilevered brackets placed at about 6 ft. centres. The fence is of concrete with pre-cast newels, blocks and rail. One of the photographs illustrates the design. The lamp posts are also of pre-cast concrete.



Hopper cars are used for carrying concrete from chute to point required.

The cantilevered floor brackets are curved on the under side to add to their appearance. A curb 6 ft. high is formed at the sidewalk which is 4 inches thick and reinforced with steelcrete. Since the bridge is humped, drainage takes care of itself.

The piers and abutments are panelled and given a moulding at the springing lines. Up to the springing lines the concrete is of a 1:3:5 mix, above that it is 1:2:4. All of the concrete is given a rubbed finish with carborundum blocks. No plastering of finished surfaces was done.

The double line of street car tracks is laid on wooden ties, concrete imbedded. The waterproofing is 2-ply heavy asphalt felt, 2-ply, 8 oz. burlap, 1-ply building paper and 1¼ inch asphalt mastic. The paving, to be done later, will be of 4-inch creosoted wood block laid on ½-inch mortar cushion.

Excavation and Concreting

The excavation for the footings was carried out by hand, scrapers and grab buckets. The pits at the south of the bridge, being shallow, were dug by hand

Deck view with waterproofing in progress.

or by horse and scraper, as in the case of the south pier. For the north abutment and pier work, where excavations were more extensive, a stiff-leg derrick with clam shell bucket was rigged up. The soil at footing level was hard and gravelly so that no piles were required.

The concreting supplies were brought in by car on the Belt Line tracks and dumped in open piles on the track embankment. The mixer was placed on the east side of the bridge site close to the creek. As the track level was higher than the mixer, the barrows could run into the piles on the side of the track and load very readily. Storage bins were thus dispensed with. A platform was rigged over the creek as a runway from the piles to the mixer.

The cement was stored in a closed shed beside the mixing plant. For unloading, a portable double skip arrangement was rigged up from the car to the shed. This comprised two small balanced skip cars on plank tracks, the force of gravity acting to draw the loaded skip down and so draw the unloaded one up to the car.

Concrete was taken to the job by a tower and spouts. Two spout hoppers were attached to the

Fence comprises pre-cast newels, panels and coping.

tower so as to accommodate the height of the work. Up to the springing lines only the chutes were employed. For concreting above that, special equipment was used. Above the arch centering, was supported a framing supporting two lines of track which carried hopper cars. These received concrete from the chutes and carried it to the place required where it was dumped through a gate controlled opening into short sections of chutes below the track framing. This arrangement was specially applicable to this type of bridge where it was required to prevent any initial stresses or unbalanced thrusts. To offset these, the concrete was always kept up to the same height over each pier. By means of the hopper cars, the concrete was easily transported and poured at the required spot without constantly shifting spouts.

The entire bridge above springing line was poured in seven units, each one running longitudinally from end to end and each poured in one day's operations. The construction joints are thus longintdinal. The fence units were pre-cast at the bridge site.

The bridge was designed by the Railway & Bridge Section of the Toronto Department of Works, of which G. A. McCarthy is engineer, J. S. Burgoyne, designing engineer, and L. V. Edwards, supervising engineer. G. G. Powell is deputy engineer.

Moose Jaw's Municipal Work

for this Year—Commissioners' Report Shows Continued Economy in Operation of All Departments

In the city of Moose Jaw, Sask., during the past year, every effort has again been used to curtail the expenses of carrying on the various municipal departments. War conditions have caused the administrators to refrain from the prosecution of any new works involving the expenditure of capital money. As in all other municipalities, the effects of the war are now being felt in nearly every department of civic activity, not only in the increased cost of labor, but in the large advances in the prices of material and in some cases the impossibility of procuring material for the maintenance of many municipal works.

Building operations in Moose Jaw for the ten months ending October 31, 1917, have been somewhat less extensive than for the same period last year. There have been but two permits issued of any appreciable value—the Ross Military Convalescent Hospital and the Robin Hood Flour Mills. The majority of the permits were for small amounts, 69 per cent. having a value of less than $2,000 each. The permits for the ten months totalled $260,710 against $312,770 in 1916.

According to a recent report for the first ten months of 1917, issued by the city commissioners, the expenditure for operating the various civic departments in 1917 was $38,000 less than in the corresponding period of 1916, and $131,000 less than in 1913, "so that it is apparent that the low water mark in the operation of these civic departments has been reached, having due regard to efficiency."

The activities directly under the control of the engineering department, together with the expenditure of each, compared with 1916, are:

	1916	1917
Board of Works	$ 23,948.42	$ 20,150.00
Scavenging	18,576.63	21,361.61
Refuse Destructor	5,487.44	3,259.80
Sewers Maintenance	3,945.94	2,379.75
Sewage Disposal	9,076.33	7,955.07
Waterworks	44,358.07	51,911.86
	$105,392.83	$107,018.09

The slight increase is almost wholly accounted for by the increased cost of labor and material.

Water Supply

The water supply was fairly well maintained during the year, the average quantity supplied per day being 1,008,000 gallons, or 59.5 gallons per head, as compared with 805,000 gallons per day in 1915. The average daily quantity used for manufacturing purposes was 215,000 gallons. The number of consumers is practically the same as at this time last year, namely, 2,122.

A great deal of trouble was again experienced from breaks in the infiltration gallery at the Caron Headworks; indeed, no water was obtained through the gallery from April to September due to this cause. The cost of repairing these breaks was $9,602.23.

In the middle of the year a contract was let for the supply of new pumping equipment for the Rosedale Pumping Station; the installation, which should be in operation early next year, will consist of one 600,000 gallons per day and two one million gallons per day electrically operated pumps, and they will displace the two 850,000 gallons per day pumps which are no longer adequate to meet the demand. The cost of the new installation will be $5,000.

The expenditure of the Board of Works Department, which takes care of the maintenance of roads, streets, sidewalks, etc., compared with last year was:—

	1916	1917
General Street Maintenance ...	$7,118.50	$4,243.23
Paved Street Maintenance	762.51	396.25
Wood Walks Maintenance ...	1,019.24	1,180.52
Cement Walks Maintenance ..	51.78	311.43
Street Cleaning	6,350.92	8,295.70
Removing Snow	874.15	875.38
Storm Sewers Maintenance ..	1,724.47	1,013.80
Bridges Maintenance	612.40	1,035.29
Superintendence	1,440.94	789.90
Miscellaneous	1,593.41	951.10
Cutting Weeds	2,400.10	1,379.85
	$23,948.42	$20,472.45

Street Maintenance with Ashes and Cinders

The past season was a favorable one for the maintenance of the city's 36 miles of graded earth roads and streets, and they were kept in a passable condition, though it must be realized by everyone that until the streets are paved with some durable material it will be impossible, especially in wet weather, even with the expenditure of large sums of money, to render them comfortable for the travelling public. Moose Jaw is in the unfortunate position of not having any large supply of gravel from which to draw and as a consequence an endeavor was made to mitigate the mud nuisance by coating a number of streets with cinders and ashes. While they last, this covering makes a fairly dry and presentable surface, and were it not for the dust nuisance caused by the disintegrated ashes in windy weather would give at least a temporary solution to the paving problem. Altogether two miles of streets were treated in this way, and 3 1/5 miles were graded.

A change in policy was inaugurated in connection with the cleaning of the paved area during the summer months by employing a squad of men to flush the streets twice every week.

Refuse Removal and Destruction

The cost of refuse, ash and night soil removal was $21,361.61, as compared with $18,576.63 for 1916; the increase being accounted for wholly by the increase in wages which amounted to 14½ per cent. in the case of garbage and 21½ per cent. for night soil work.

There were 6,506 tons of garbage and ashes removed as compared with 7,091 tons for 1916.

An important change was made early in the year in the method of charging for the service rendered in connection with garbage and night soil removal. It was felt that as the removal of garbage was a direct service to the householder he should pay for such service, and a fee of $3.00 per annum was accordingly levied against each householder in this connection. A special assessment of $6.00 was also made on the owners of all property not connected with the sewerage system, as by the special assessment made on property owners on the water line the owners of unsewered property were relieved of this portion of the waterworks tax.

The reduction in the cost of operation of the refuse destructor is due to the policy adopted of closing down this plant during the winter months. When the destructor was built it was anticipated that it would be kept in operation continuously 24 hours per day, but owing to the economy exercised by the citizens during these war times the reduction in the refuse delivered to the incinerator was such that it could only be operated economically 10 hours per day, with the result that the cost per ton of refuse destroyed increased considerably. In order to obviate this high cost it is more economical to close the plant from November to March each year, sending the refuse to the nuisance ground and simply have the plant running during the summer season when danger from flies would render it inadvisable to dispose of garbage at the nuisance ground. The quantity of refuse destroyed this year amounted to 1,421 tons, as compared with 2,758 tons last year.

Sewers and Sewage Disposal

The total length of sanitary sewers is 37.15 miles, of which .10 miles were laid this year. The expenditure on maintenance of the sewerage system is considerably under that of last year and this notwithstanding the fact that an outlay of about $1,000 was incurred at the beginning of the year in cleaning a sewer block in the trunk main on Maple Street.

These works have undergone no great change during 1917. The Ham-Baker automatic travelling distributors which were installed in the fall of last year have given great satisfaction and are producing an effluent of a very high degree of purification compared with that of former years, and this is further borne out by the fact that very few, if any, complaints are now received during the summer months regarding smells from the sewage disposal plant. The average daily flow of sewage amounted to 822,000 gallons as compared with 975,000 gallons last year. All this sewage has to be pumped and an electrically operated centrifugal pump was installed in the fall of last year to take the place of the ejectors. Ninety per cent. of the sewage this year has been pumped with this pump at a very great saving in the amount of electrical energy consumed as compared with the ejectors, the figures being: 1916, 163,647 kw.h., and 1917, 75,920 kw.h. This saving accounts mainly for the reduction in the cost of operation of the plant for the past ten months.

According to the annual report of the Public Works Department of the Province of Quebec up to June, 1917, the number of iron bridges constructed was 427, the number of bridges under construction was 54, and the cost of bridges up to that date $2,873,657.

In connection with the building of the Montreal aqueduct, the claims of the Cook Construction Company amounted on November 22 to $1,922,217, while the city's counter-claims total $1,832,437. The dispute will go to arbitration.

The annual meeting of the Association of Architects of the Province of Quebec will be held at the Association's rooms, Quebec, on January 19.

Quebec Bridge Superstructure Details Described to C. S. C. E.

THE second of the series of addresses on the design and construction of the Quebec Bridge, by men who were responsible for this famous structure, was given by Mr. George F. Porter, M.C.S.C.E., chief construction engineer of the St. Lawrence Bridge Company, on December 6, at the rooms of the Canadian Society of Civil Engineers, Montreal. As on the occasion of Lieut.-Col. Monsarrat's address, there was an exceptionally large attendance. Mr. Walter J. Francis presided, and referred to the assistance rendered by American engineers, Mr. Porter being one of those whose co-operation had been secured.

Lieut.-Col. Monsarrat dealt mainly with the substructure, while Mr. Porter's address was on the erection of the superstructure. In some respects, notably that of the anchor arms, Mr. Porter elaborated points touched on by Lieut.-Col. Monsarrat. The next address will be on December 20, when Mr. Phelps Johnson, president of the company, and ex-president of the Society, will speak on the work in the shops.

Mr. Porter's address was, as he termed it, an informal talk, and was in fact a description of a large number of slides showing how the superstructure, the anchor and cantilever arms, were built up. Altogether some 800 photographs were taken, and, said Mr. Porter, the difficulty was to make a selection from the mass of material at his disposal. The talk served to illustrate the minute care which was taken to ensure that the manufacture of the members and their erection should proceed smoothly, great attention being paid to the smallest details. A model of the traveller was made, taking one man eight months, in order that there should be no hitch in this section. Mr. Porter referred to many problems which had to be solved, and spoke of the co-operation between all departments in order to make the job a complete success.

Mr. Porter stated that the truss was a type which had never been used previously on the American continent, and had only been employed to a minor extent in Europe. He then described the anchor arms and travellers, stating that the former were in some respects the most difficult sections to erect. The travellers were equipped with booms on the four corners, the controllers being electrically operated. The swinging of the booms was effected by means of a 4-ft. bull wheel. There was not the slightest difficulty in working the booms even with the wind at 35 miles an hour. The hoists were all electrically operated, there being 27 electric motors to each traveller. No friction drums were used on the hoists; dynamic breaking was employed, as had friction brakes been used they would have burned out.

The methods of placing the floor beams, the castings under the main shoes (each casting weighed 35 tons), and the placing of members in place on the anchor arms, in various stages of erection, were discussed. Mr. Porter stated that the pins, weighing five and six tons, were driven by pieces of T-rail weighing about 300 pounds. Many of the pictures illustrated the building up of the main posts, consisting of four sections; some pieces weighed 75 tons and had to be conveyed from Montreal in pit cars.

The cantilever was then dealt with, Mr. Porter explaining that smooth running was provided for by each foreman being supplied with plans and data showing the exact order in which material was required. The result was that no delays occurred by reason of waiting for material. The riveting proved very satisfactory; some joints had 3,000 rivets, and of this number only three or four had to be cut out in order to pass the inspector. The whole of the trusses were made in halves, constructed in the shops, and riveted on the job. No difficulty was found in adjusting the halves.

Another series of pictures illustrated the building of the suspended span at Sillery and its floating to the site on scows. Then followed slides showing the placing of the span in place, the arrangement of the jacks and chains, air pipes, control, tell-tales, etc. Finally Mr. Porter explained, by a few slides, how in the opinion of the Bridge Company, the disaster to the first central span occurred, due to an explosion in the casting, and also the means taken to obviate another failure from this cause.

On the motion of Mr. R. A. Ross a vote of thanks was passed to Mr. Porter.

Prior to the address, a vote of sympathy with the citizens of Halifax, proposed by Mr. Tye and seconded by Mr. Ross, was passed. Mr. Keith, the secretary, was requested to telegraph the message to the Mayor of Halifax. A vote of sympathy to Captain Duchastel, who was to have presided, was also passed. Captain Duchastel sustained a fracture of the shoulder owing to a fall.

Quebec Public Works

The Quebec Government has officially announced its intention to introduce a further Bill in the interests of the good roads movement. The Government, in the Speech from the Throne, refer to the construction of a road between Three Rivers and Grand'Mere, which will probably be finished next summer. The building of the dams at the head of the St. Maurice and St. Francois Rivers (now nearing completion) for the storing and flow of their waters, will, it is stated, be of great value to the province. The object the Government had in view in building these reservoirs was to increase the power upon which the greater part of the industrial development of the province depends and the work it had done there was one of which the people might rightly be proud.

Report on Iron and Steel Situation

The war's demand for steel has had the effect of stimulating Canadian production of pig iron and steel to larger outputs than any previously recorded, according to a recently issued report entitled "The Production of Iron and Steel in Canada During 1916." This, however, is an industry based largely on iron ores obtained outside of Canada. The actual shipments of iron ores from the Canadian mines was less in 1916 than the previous year, notwithstanding the higher prices in effect, and the total was less than 14 per cent. of the entire iron ore consumption in blast furnaces and steel plants. The recorded export and import of iron and steel products were considerably higher than in either of the two preceding years.

Bridge Building in the French War Zone

Engineers Accomplish Three Bridgings of the Aisne River Under Fire — Permanent Steel Structure Finally Placed

ENGINEERING plays a very important role in the great war. Indeed, it has often been repeated that the struggle is an engineering one and that it is the engineer-soldier who must bear the responsibility of keeping the armies equipped and prepared for every requirement. So valuable have the services of the engineering battalions become, that, under the present organization of the war forces, such units are now largely "directing" or "superintending" units, that is to say, the soldiers of these engineering battalions, for the most part, men of practical training, act as supervisors over works, the labor for which is provided from combatant infantry units.

Little has been permitted to be said about the accomplishments of the engineering forces at the front. Not until after the war, probably, will we be allowed to hear of all the wonderful achievements wrought under the most distressing and harrowing difficulties. It is with interest therefore, that we read such descriptions of the engineer's work in the war, as may chance to be made public. The following article reprinted through the courtesy of Engineering News-Record, is descriptive of the feats of the French engineers at the Aisne River, last spring and summer. It is written by Robert A. Drake, a former ambulance driver with the American Red Cross in France:—

Bridge construction in war time tests to the utmost the engineer's powers of adaptation and resourcefulness. Quick action and results are necessary, both for saving the lives of the workmen and for preventing the needless destruction of expensive machinery.

Small Steel Pontoons for First Foot Bridge

French engineers accomplished a notable feat in spanning the Aisne River at ——— during the latter part of April and the first two weeks in June, 1917. On April 15 a terrific curtain fire from the French artillery forced the enemy to bury themselves in their dugouts 1,000 yards from the north bank of the river. The French engineers then faced their first problem in bridging the stream; to make it possible for the French troops to cross the river and establish their lines on the other side. On the south bank, at right angles with the line of flow of the Aisne, 14 steel pontoons, each 8 ft. long and 3 ft. in diameter, were laid parallel with one another at intervals of 10 ft. On top of these boats, 10-ft. sections of board walk, made of 3 x 4-in. beams with boards 2½ ft. long nailed across them, were placed so that the joints between the sections were directly over the center of the boats. Large iron hooks fastened the timbers together in order to give flexibility to the floating bridge when the pontoons rose or fell as the load on any particular section decreased or increased.

All this work of assembling had to be done under heavy shell fire from the German batteries. At a given signal the engineers pushed the end of the foot-bridge out into the river. Then a new difficulty arose; the current of the stream had such a tendency to carry the floating end of the bridge downstream that the first pontoon failed to reach the other bank by 30 feet. The bridge was finally shoved across by letting the whole structure float down the current until its center struck the abutment of the old bridge. Then two men pushed against the masonry until the whole bridge swung up to make a 90-deg. angle with the bank. As soon as the end touched the farther bank, four men made the bridge fast by driving stakes in the earth and fastening steel cables from them to cleats on the first pontoon.

Larger Bridge for Heavy Traffic

Over bridges like these the first French troops charged in numbers that finally forced the Germans to retire to a line of hills three-quarters of a mile from the river. These original foot-bridges were retained even after permanent structures were built, in order to relieve the congestion on the other bridges and also prevent the German baloon observers from estimating the number of troops coming up. The foot-bridges were close to the water and hence better concealed by the banks than the higher wooden or steel spans.

The second problem of the engineers was to provide means for getting trench supplies across the river to the Frenchmen on the north bank. The bombardment was still too heavy to permit an attempt to erect a steel structure, but the small foot-bridges were inadequate in size and strength for supporting the ever-increasing loads of food and trench munitions needed. A bridge large enough for pack mules and small horse-drawn carts was necessary.

The large pontoon bridge solved the problem. Seven steel scows, each 35 ft. long, 4½ ft. wide and 3½ ft. deep, were brought up on large six-horse trucks. Each boat was turned bottom up on the flat timber bodies of the trucks, and kept from sliding sideways by a wooden support shaped like a broad U, under each end of the boat, and by ropes fastened from these U's to cleats inside the pontoons.

On the banks of the stream a hawser from one end of each boat was fastened to a stake driven into the earth. Then the horses pulled the wagon from beneath the boat, and soon after the pontoons were launched one after the other with the bows pointing upstream. The planks of the runway on top of the boats were laid diagonally, and fastened at the edges by 8-inch beams that also kept wheels of carts from running overboard. As the floor of this bridge was 15 feet below the top of the bank, a wooden runway similar to that on the bridge led over the soft, shell-pitted earth from the end of the bridge to the macadam road above. But this large pontoon bridge was used only temporarily.

Erecting Steel Bridges Under Fire

As the Germans were driven back to a point 2½ miles from the river, the third and final problem presented itself to the engineers; to span the river with permanent bridges strong enough to support the weight of the advancing artillery, heavier munition wagons, auto trucks and narrow-gauge railroad trains.

All this construction had to be done within full sight of the German observation balloons that signalled their batteries to hinder and, if possible, prevent the work entirely. At another point farther down the river, higher hills on the northern side of the valley cut off the visibility from the enemy balloons to a greater extent, but this factor of safety was sacrificed somewhat in order to utilize the abutments of the old bridge. The Boches had placed heavy charges of nitroglycerine on the centre of the trusses, and as a result of the explosions the twisted steel, fallen away from the abutments, was lying in the river below. In their haste the Germans had been forced to leave the masonry intact, but the solidity of the stonework was carefully tested by the Frenchmen before they utilized the piers. There was more than a chance that the wily Boches had secretly updermined the stonework.

Before the war, part of the Aisne at this point had been diverted so that two bridges had to be constructed, one a single span 100 ft. long over the canal, and the other a double span, 220 ft. over-all, over the main body of the river.

A narrow-gauge railroad was constructed from the engineers' park (supply station), three miles farther in the rear, to the river, in order to bring up the steel and other heavy supplies. The hauls were made by a four-cylinder gasoline locomotive that could draw three loaded trucks at a maximum speed of 8 miles per hour.

Artillery and Airplanes Increase Difficulties

The motto of the French engineers was: Use expensive machinery under shell fire for as short a time as possible. So the derricks, piledrivers, trusses and other supplies were not brought up until every possible preparation had been made. There was plenty of labor at the front; the conservation of material was the real problem.

Just as the work was well under way, the German aeroplanes "spotted" the increased activity of the engineers and directed the artillery to increase its firing. The hostile aeroplanes also dropped bombs on the works, so the natural difficulties of the engineers' task were considerably augmented by these human hindrances.

I was driving an ambulance in an American Sanitary Section (Section 5, American Red Cross) at the time and our cars carried an average of seven wounded engineers a day—all hit either on or near the bridge. Although dugouts were provided for the men in case the bombardment became too heavy, the workmen preferred to stay at work in order to finish the construction as soon as possible.

The principle of bridge-separation guided the work of the engineers throughout. Rather than build a single bridge broad enough for traffic going in two directions simultaneously, the Frenchmen erected two narrower bridges separated by at least 150 feet, although the work involved much more time and labor. The purpose of this separation was obvious; during a bombardment the chances of the shells cutting the lines of communication were lessened considerably by decreasing the width of the bridges, and placing the spans at a considerable distance from each other.

I had a good opportunity to observe the practical value of this method of construction one night when the artillery fire was unusually heavy, for the Boches were trying to keep the supply teams from coming up. On the trip down I crossed the bridges safely with my load of wounded, but on the trip back, shells hit both bridges. The wooden bridge I had passed over on my way down was so badly damaged that traffic could not pass over it at all, but—here the advantage of steel over wood construction was clearly evident—although a shell had hit the steel structure, teams and autos could still drive over the river. I crossed the span over the canal without mishap, but once on the island I was stranded. The traffic over the narrow one-way bridge was hopelessly congested by the double load of teams trying to come down as well as go up. Two teams could pass on the island where we were, but not on the bridge, so there was nothing for us to do but to "sit tight" and wait our turn. I have spent many pleasanter moments than that quarter-hour out there in the blackness, listening to the shrieks of enormous shells aimed at a target only 10 feet away! When it finally came our turn to move, a French teamster behind us galloped ahead and blocked the way. I know enough French to express myself on ordinary occasions, but I knew nothing but vivid English at that moment.

"You blankety blank blank toasted-in-Purgatory Frenchman, you," I yelled, completely forgetting that the poilu couldn't understand a word I was saying, "get out of my way!"

The very evident emphasis of my remarks made some impression on the teamster's mind, if the words didn't. He pulled out to one side of the road and a few seconds later I was safely out of the danger zone.

The workmen could not make any repairs on the bridge that night because "no lights" was the rule so near the trenches, but at daybreak the next morning the reserve staff of engineers, who lived near the bridge to take care of just such emergencies, were at work repairing the shattered railing. The narrow-gauge railroad that passed over the steel bridge also needed rebuilding, so the reserve section of combined steel ties and rails was picked up from beside the road and substituted for the broken section.

Policemen Control Traffic

The gendarmes, who lived in dugouts at either end of the bridges, strictly enforced the one-way traffic rule when both roads were open. As these officers had orders to shoot down any driver that disobeyed orders we were careful to drive over the steel bridge when we went toward the lines, and over the wooden bridge when we were going in the other direction. As the munition teams had their heavy loads of shells going up, the steel structure was used for all the up-bound traffic.

When the teams or autos approached the bridge the policemen made every vehicle keep at least 50 yards behind the one ahead. This was done for two reasons —first, to make a more scattered target for the German artillery, and, second, to eliminate a possible overload on the bridges. The macadam road near the approaches was always well sprinkled to keep passing wheels from stirring conspicuous clouds of dust that could be seen by hostile observers, and the maximum speed was reduced to 8 miles per hour.

After the bridges were completed camouflage played an important part in protecting the structures from shell fire. All the steel trusses and woodwork were painted a moss green color, the shade of the water below, for the secret of camouflage is to imitate the background as closely as possible. This green paint concealed the bridges from view of German aeroplanes. On either side of the road, at the ends of the bridges nearest the trenches, two 35-ft. poles were erected, and between these poles a ½-inch wire cable supported a screen of heavy chicken wire that hung down to within 10 feet of the roadbed. Bushes and bits of painted cloth were interwoven in this wire until the whole camouflage made the poles appear exactly like one of the dead trees all along the bank.

Conservation of Electric Power in Canada

Reservation of Our Water Power Facilities Essential if Shortage is to be Avoided—Hydro-Electric Development on the St. Lawrence

By Arthur V White*

It will be ten years next May since the conference of governors called together by the President of the United States held its memorable meeting in Washington, and as a result of which the Commission of Conservation of Canada was constituted.

Policies adopted at this Washington conference and subsequently carried into effect have markedly affected not only the United States, but also Canada, and, indeed, the world at large. It was so clearly demonstrated that several of the chief natural resources of the United States were within measurable distance of exhaustion that prompt action by the trustees of the nation was imperative.

Addressing the conference, the President of the United States said:

"This nation began with the belief that its landed possessions were illimitable and capable of supporting all the people who might care to make our country their home; but already the limit of unsettled land is in sight, and, indeed, but little land, fitted for agriculture now remains unoccupied save what can be reclaimed by irrigation and drainage. . . . We began with an unapproachable heritage of forests; more than half of the timber is gone. We began with coal fields more extensive than those of any other nation and with iron ores regarded as inexhaustible, and many experts now declare that the end of both iron and coal is in sight. . . . The enormous stores of minerals, oil, and gas are largely gone. . . . Our natural waterways are not gone, but they have been so injured by neglect and by the division of responsibility and utter lack of system in dealing with them that there is less navigation on them now than there was fifty years ago. Finally, we began with soils of unexampled fertility, and we have so impoverished them by injudicious use and by failing to check erosion that their crop-producing power is diminishing instead of increasing. In a word, we have thoughtlessly, and to a large degree unnecessarily, diminished the resources upon which not only our prosperity but the prosperity of our children and our children's children must always depend."

The Commission of Conservation of Canada has been endeavoring to have the natural resources of the country developed in a manner which will, so far as possible, pass them on to succeeding generations unabused by the uses to which they must now necessarily be applied. In this connection special attention was devoted to the beneficial use and conservation of Canada's water resources, and some of the earliest activities of this commission consist of investigations respecting the character and extent of the water-powers of Canada. In presenting the results of their research, the commission, from time to time, has advised respecting such subjects as water-powers development, the improvement of navigable rivers, the necessity for protecting against damage by flood, the preservation of soils against erosion, the conservation of underground waters, as well as upon other matters related to our water resources.

Some resources, such as minerals—perhaps more especially coal, oil, and gas—if used, must, in time, necessarily become exhausted. On the other hand, such resources as the soil, plant growth, waterways, and ground waters, may be conserved; and, just as a good husbandman passes on his farm in an improved condition to that in which he received it, so the policies advocated by this commission have been directed to the passing on to succeeding generations in an improved condition the heritage of the natural resources of this country.

*Consulting engineer to the Commission of Conservation; before annual meeting of Commission.

St. Lawrence River Powers

We are now briefly to consider, chiefly in its economic aspects, one of Canada's great natural assets—the water possibilities of the St. Lawrence River.

The water-powers of this river, as yet, are largely within the control of the people. There is, however, a shortage of hydro-electric power which is being keenly felt, both in Canada and the United States, and at present strong efforts are being made by private interests to obtain control of the enormously advantageous power in, or adjacent to, the international boundary.

The city of Montreal and vicinity is, for a time at least, well supplied with electric energy, but, comparatively speaking, the rates are high. If more energy were available—as could be the case—at considerably lower rates, electric power and light would be much more extensively used both in factory and home.

Power Shortage in Eastern Ontario

There has been great shortage of power for supplying municipalities in Eastern Ontario. At the present time the Hydro-Electric Power Commission of Ontario have urgent requests from such municipalities as Brockville, Prescott, Winchester, Chesterville, Cornwall, Mille Roche, Smith's Falls, Perth, Carleton Place, Kemptville, and Almonte, for electric power to take care of connected loads aggregating from 15,000 to 20,000 h.p., with a present peak load of not less than 8,000 h.p.

Although Eastern Ontario has not been so extensive a manufacturing centre as Southwestern Ontario, nevertheless it is well to recall that in the fall of 1910, when the Hydro-Electric Power Commission of Ontario commenced operating its Niagara system, it was supplying only about 8,000 h.p. On this system alone it is now—in the fall of 1917—supplying more than 100 municipalities, taking over 200,000 h.p., and, in addition, some 50,000 h.p., is supplied in the Niagara district to munition plants.

The power shortage in Eastern Ontario of late has become acute. It had been hoped that power would have been available from the large development at the Cedars on the St. Lawrence River, but this power, although conveyed through the territory of the municipalities requiring power, was taken en bloc to the works of the Aluminum Company of America, situated at Messina, N.Y.

From time to time it has been suggested that some of this power might be brought back from Messina to Canada for supplying the needs of Canadian municipalities. This, however, has not been done, but, instead, distributing systems have been established for supplying, from Messina, various municipalities in the northern part of the State of New York. Great industrial advantage has followed the utilization in the United States of the electrical power generated in Canada at "The Cedars," on the St. Lawrence River, and exported to Messina, N.Y.

During recent hearings, conducted by the Committee on Foreign Affairs of the United States House of Representatives at Niagara Falls, N.Y., and elsewhere, one point which was prominently emphasized by representative citizens was that the United States could not afford to permit industries to go outside of the country and locate in other countries where cheap power was being offered; and it was emphasized that industries requiring large blocks of power were often compelled to go to places where the power could be had. The United States has already lost industries to Norway and to Canada.

There is very strong opposition, especially throughout Ontario, to any policy which permits the exportation of Canadian electrical energy required for use in Canada. The Federal Government was memorialized upon this subject. It has been urged that no large power projects, such, for example, as those on the international portion of the St. Lawrence River should be developed without reserving, for use in Canada, her share of the power; and, further, that such power as exists wholly in Canada should be reserved against the day of Canada's need

If power is developed, as is proposed, for example, at the Coteau Rapids, it is much more important that it be available for supplying the needs of such municipalities in Quebec and Ontario as would naturally be served from such power than that the power be exploited by private interests, or exported and employed to build up industries in the United States.

The proposal to which I refer is that of the Power Development Company, Limited, who are applying for the rights of power development at the Coteau Rapids.* The Commission of Conservation and other organizations are opposing the project.

Coal Situation

As never before, the public interest has been aroused respecting both its fuel supply and its increasing dependence upon hydro-electric energy. The central portion of Canada depends for its coal upon the United States. The present war conditions are going to drive home to Canadians as never before the tremendous gravity of their position with respect to fuel. If large quantities of electric energy be available at sufficiently cheap rates, it will doubtless be much more extensively employed for certain heating and other domestic uses now served by coal. Precaution must be taken, however, to ensure absolutely against wasteful uses.

Specific statements respecting the coal situation, especially in its broad national bearing, are published in my earlier reports. In 1910, referring to this subject, I used the following words, which are equally true to-day:

"Certainly the people of Canada are in better circumstances to maintain a supply of heat and power if their water-powers, including their full share of international water-powers, are reserved to themselves and not permitted to be exported except upon terms and conditions which will conserve absolutely the present and future interests of the citizens of Canada. Not only would the water-powers of Canada provide, to a certain extent, a substitute for the coal supply of the United States as a means of furnishing light and heat and power, but control of these water-powers would secure a basis upon which negotiations for coal could be conducted in a possible day of need. Canada would be in a position to exchange, if need be, part of her electric energy for part of the coal supply of the United States. It is obvious, however, that if the United States interests should control both the coal and the water-powers the situation of Canada would become exceedingly grave."†

I shall not here enlarge upon the coal situation, but shall deal more particularly with the power situation and the shortage of hydro-electric energy.

Concentration of Control

Most of the water-powers which are more readily capable of economic development in Canada, as well as in the United States, either have already been developed or are privately controlled. Concentration of ownership is a noticeable feature of this control. It has been authoritatively published that in the United States, in 1913, about 6,300,000 h.p. was controlled by ten groups of interests. This concentration is still going on. Owing both to provincial and federal legislation it has not been possible for interests so readily to obtain control of water-powers in Canada. Efforts, however, are continually being made to secure the rights for such desirable water-powers as are yet vested in the state. The efforts made by the powerful financial interests behind the Long Sault Development Company to obtain control of the almost unequalled power rights at the Long Sault Rapids, on the St. Lawrence River, are still in mind.

The public cannot be too well informed respecting the extent to which they may be compelled to pay tribute to those concentrating hydro-electric powers, by reason of the control which such interests have over the distribution and supply of electrical energy. Referring to this concentration of control, Mr. Gifford Pinchot has stated:

"And whoever dominates power dominates all industry. Have you ever seen a few drops of oil, scattered on the water, spreading until they formed a continuous film, which put an end at once to all agitation of the surface. The time for us to agitate this question is now, before the separate circles of centralized control spread into the uniform, unbroken, nation-wide covering of a single gigantic trust. There will be little chance for mere agitation after that. No man at all familiar with the situation can doubt that the time for effective protest is very short. If we do not use it to protect ourselves now we may be very sure that the trust will give hereafter small consideration to the welfare of the average citizen when in conflict with its own."

Respecting the water-powers of the United States and the attempt to create a monopoly of same, Mr. Roosevelt, when President of the United States, in accurate prophetic terms stated:

"The people of this country are threatened by a monopoly far more powerful, because in far closer touch with their domestic and industrial life, than anything known to our experience. A single generation will see the exhaustion of our natural resources of oil and gas, and such a rise in the price of coal as will make the price of electrically transmitted water-power a controlling factor in transportation, in manufacturing, and in household lighting and heating. Our water-power alone, if fully developed and wisely used, is probably sufficient for our present transportation, industrial, municipal, and domestic needs. Most of it is undeveloped, and is still in national or state control. To give away without conditions this, one of the greatest of our resources, would be an act of folly. If we are guilty of it, our children will be forced to pay an annual return upon a capitalization based upon the highest prices which 'the traffic will bear.' They will find themselves face to face with powerful interests, entrenched behind the doctrine of 'vested rights' and strengthened by every defence which money can buy and the ingenuity of able corporation lawyers can devise. Long before that time they may, and very probably will, have become a consolidated interest, dictating the terms upon which the citizen can conduct his business or earn his livelihood, and not amenable to the wholesome check of local opinion."

This prophecy of the ex-President is daily in process of fulfillment. Canada cannot afford to have her St. Lawrence River powers pass into the hands of powerful private interests.

Inconveniences of Curtailed Output Reduced By Contract Stipulations

There has been a marked general tendency to exaggerate the quantities of water-power which may be developed. For tentative estimate of the power of the St. Lawrence we shall assume that practically the full low water flow of the river would be available for power development

If large power development should take place in the St. Lawrence River, considerable quantities of the electrical energy would, for a time at least, probably be utilized by electro-chemical industries The tendency of vendors of elec-

*Re application to the Dominion Government made under the Navigable Waters Protection Act– R.S.C., chapter 115, see "Canada Gazette" for September 22, 1917, p. 969.

†Respecting various phases of this subject, consult an article by Arthur V. White on the "Exportation of Electricity," which appeared in the "University Magazine," October, 1916, pages 460 et seq. Consult also "Toronto World," 18th March, 1912; also "Exportation of Electricity—An International Problem: Relation of a Possible Coal Embargo by United States to a Curtailment or Stoppage of Canada's Electric Power," in the "Monetary Times" of January 5, 1917, pages 21 et seq. Consult also "Annual Reports of Commission of Conservation," Ottawa.

trical energy, in contracts with such large power-users as the electro-chemical industries is to stipulate that such customers must curtail consumption at times when there is depletion in the generated supply owing to unavoidable causes. By means of such contract arrangements the requirements of municipalities and of industries requiring smaller amounts of power continuously may be safeguarded.

Possible Power Sites

On the St. Lawrence River, below Lake Ontario, the first site where a power development could be made is in the vicinity of Morrisburg. With a dam near the foot of Ogden Island, a head could be obtained of about 11 feet, or if a portion of the Galop Rapid were included, possibly an effective head of about 15 feet could be obtained. If utilization of the Galop Rapid be contemplated, then the question of regulating works to control the level of Lake Ontario becomes an important factor. In fact, for power developments on the St. Lawrence the regimen of flow from, and storage in, each and all of the Great Lakes must be taken into consideration.

The next possible development is that at the Long Sault Rapids, where a head of about 35 feet may be created. The head which may profitably be developed at this point has, by some engineers, been estimated at less than 35 feet: others estimate that it might be increased to about 40 feet.

Descending the river, we have next, in a stretch of about 14 miles between Lake St. Francis and Lake St. Louis, three series of rapids—the Coteau, the Cedars, and the Split Rock and Cascades. At the Cedars the Cedars Rapids Manufacturing and Power Company have constructed a large power plant, to which additions are now being made, and which, ultimately, will utilize, by diversion, 56,000 second-feet.

The Cedars Rapids Company utilize a head of about 32 feet, developed by means of a diversion canal some two miles long. The power-house at the foot of the canal is designed for an ultimate development of 180,000 h.p. At present units aggregating some 100,000 h.p., are installed. Extensions for two additional units are now being made. This company is exporting to the United States over 65,000 h.p., which is used in the plant of the Aluminum Company of America at Messina, New York State.

Coming next to the Lachine Rapids, below Lake St. Louis, we have a head of about 30 feet in four and one-half miles. Here about 17,000 h.p. have already been developed. The total undeveloped possibilities of the river at this point may be estimated at about 400,000 h.p.

What 65,000 h.p. Could Do

Few people have any conception of what the 65,000 h.p. now being exported to the United States by the Cedars Company would mean if widely distributed to customers of light and power, such as are found in our cities and towns. For instance, the Toronto Hydro-Electric Commission, supplying both light and power to over 40,000 customers, up to the end of 1916 met requirements with a little less than 50,000 h.p. The rates for light and power in Toronto are low, much lower, for example, than in Montreal. Including the requirements of the Toronto Street Railway, Toronto Electric Light Company, and the Toronto Hydro-Electric Commission, there is now required for light and power in the municipality of Toronto about 120,000 h.p..

It may be said, therefore, that the 65,000 h.p. exported to the State of New York from the Cedars could supply, at cheap rates, all the light and power required by a representative manufacturing city of 300,000 or more inhabitants, or would supply light and power to upwards of 35 average manufacturing cities of 10,000 inhabitants each; or it would take care of one-third of the present operations of the Ontario Hydro-Electric Commission in its Niagara system, which supplies over 100 municipalities and over 100,000 customers.

When the benefits resulting from power thus widely distributed are contrasted with the localized benefits from the same power utilized in bulk, as in the electro-chemical industries, it will be perceived how much more the former than the latter contributes to the upbuilding of communities and the growth of the country at large.

Is it surprising that the former United States Secretary of War, Hon. Henry L. Stimson, stated, respecting Niagara power, that:

"The investigation [re power at Niagara Falls] which has been made by the engineers indicates that Canada, if we do not take it, will use the entire amount that the treaty permits in a very brief time, . . . and it would result in giving to Canada, very possibly, a large number of industries which otherwise would be established on this side of the falls."

In a report to the chief of engineers, United States army, Lieut.-Col., J. C. Sanford states:

"If advantage of power generated in Canada cannot be had on the American side, manufacturers will be attracted to Canada by this cheap power, and the industries of this country [the United States] will suffer accordingly. The effect of present restrictions on the importation of power is becoming noticeable. . . . Manufacturers at present contracting for additional Niagara power must locate, and are locating, in Canada."

The sub-committee on Niagara Falls power, appointed by the United States House of Representatives Committee on Foreign Affairs, states that it had been urged for its attention:

"That the Canadian companies were rapidly increasing their sales and would very soon take the full amount of water they were entitled to and the United States ought to get what power it was able to **now.**"

And they add:

"If the advancement in the development of power on the Canadian side increases for another year or so—and it is not apparent to the committee that it will not—then the committee concluded that it was proper to take as large an amount as it could get for consumption in the villages, cities, factories, and homes along **our** border."

Now, if, after giving full and just consideration, in its international aspect, to the vital subject of Canada's coal supply, it is found that the electrical energy generated in Canada can be retained for use in Canada, then highly beneficial results will be achieved which are unobtainable if the electricity is exported to the United States.

Summary of Power Sites

In summarizing the St. Lawrence water-powers, we may estimate the low-water power of the portion of the St. Lawrence River which is traversed by the international boundary, at about 800,000 h..p., of which Canada is entitled to one-half, or 400,000 h.p.

The amount of power which lies wholly within Canada would be about 1,400,000 h.p. This, with its share of power along the international boundary, makes an estimated total for Canada of 1,800,000 low-water continuous horse-power.

It may representatively be detailed as follows:*

Water-Power on the St. Lawrence River

(Tentative schedule.)

Site.	Maximum head available. Feet.	Maximum estimated low-water 24-hr. horse-power.	Average estimated 24-hr. low-water h.p. (say).
1. Morrisburg-Rapids Flat	15	230,000	200,000
2. Long Sault Rapid	40	650,000	575,000
3. Coteau Rapid	17	260,000	250,000
4. Cedars Rapid†	32	525,000	500,000
5. Split Rock and Cascades Rapid	18	280,000	250,000
6. Lachine Rapid	30 (?)	450,000	375,000
Total	-	2,395,000	2,150,000

*In this table some allowances have been made for efficiency and other factors, in order to have the estimates fairly representative of the possible quantities which might be expected under representative low-water flow conditions.

†Under development for about one-third of the low-water flow of the river. Consideration would be given to the possibility of combining Sites Nos. 3, 4 and 5; also of increasing No. 6.

Owing to the fact that vendors of power are able to adjust their deliveries, it is frequently possible to sell power which, during other hours, is used by another consumer. Thus, by way of example, the Hydro-Electric Power Commission of Ontario, by taking into consideration what is technically known as the "diversity load factor," can, I understand, supply contract requirements of 320,000 h.p., with a power capacity of 250,000 h.p.; therefore, assuming such a basis for the St. Lawrence River powers, Canada's 1,800,000 h.p. would take care of a power demand of some 2,400,000 horse-power.

The Ice Menace

In passing, permit me just to state that power development on the St. Lawrence River cannot properly be considered apart from the subject of the ice menace. In the special report dealing with the Long Sault power project*, attention is drawn to the great menace which exists in the ice conditions manifested in the St. Lawrence River.

Too great caution cannot be exercised before attempting to harness natural forces of such magnitude as exist in the flow of the St. Lawrence River—a too radical disturbance of the balance which Nature seeks to maintain may evoke disaster. These aspects of the problem of power development in the St. Lawrence are here emphasized, because they involve the weighing of basic physical factors of paramount importance.

Toronto Hydro-Electric Commission

In concluding, I shall briefly refer to one or two phases of the present power shortage and the rapidly increasing demand for electric energy.

The Toronto Hydro-Electric Commission, which obtains power through the Hydro-Electric Power Commission of Ontario, and distributes light and power to Toronto, commenced operations on June 1, 1911, with about 400 customers. At the present time—November, 1917—there are over 50,000 customers. To take care of this business has necessitated an outlay on the part of the municipality of Toronto of about $8,000,000. The operations of the commission, taking care of the 1917 December load, will, it is expected, require about 75,000 h.p. At the present time only about 50,000 h.p. is available. The Toronto commission is exerting every effort to compress its load and to hold back even the natural increase in the requirements of its present customers. It can take on no new customers, and of late has been issuing special appeals to present customers "to use as little current as possible until further notice, particularly from 4.30 to 6 in the afternoon on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays, and so help to avoid a possible shortage for munition plants and other essential industries. The commission states that:

"Every economy, however small, will help to achieve the result aimed at. If each of the 50,000 Hydro customers in Toronto uses even one or two lights less during these hours it will mean a greater reduction than though the whole of the street lights in Toronto were turned off."

There is no doubt that a great deal of power and light are needlessly wasted. There was a time—and not very long ago—when the vendors of electrical energy were offering special inducements to encourage consumption, and customers were invited to use new electric devices as rapidly as such could be invented. The public has responded to these invitations, and now—assuming that there is not a set-back to industrial activity—Ontario is faced with a power shortage which, until relieved, must constitute a serious check to her industrial growth.

*See report "Long Sault Rapids, St. Lawrence River—An Enquiry Into the Constitutional and Other Aspects of the Project to Develop Power Therefrom," by Arthur V. White, Commission of Conservation, Ottawa, 1913.

Power for War Munitions

The Hydro-Electric Power Commission of Ontario at present requires for munitions an additional 140,000 h.p. This, however, they are not able to supply. Including the contract with the British Forgings, Limited, the commission at present is under contract to supply about 95,000 h.p.

The average individual has little idea of how diverse and extensive are the demands upon manufacturers for materials of war. A recent photograph shows a French soldier at his post with such individual equipment as rifle, grenade-throwing gun, pistol, package of powder to be used against gas, a basket of hand-grenades, bag of sand, pickaxe, gun-grenades, signal lantern, alarm bell for gas attacks, small reel of barbed wire, rocket scoop, corrugated iron hatch-grate, shovel, wire-scissors, course broom, periscope, gun-carrier with periscope, and a gabion.

The Hydro-Electric Power Commission of Ontario at such centres as Niagara Falls, Welland, Toronto, Hamilton, Dundas, London, St. Catharines, Brantford, Kitchener, St. Thomas, Stratford, Guelph, Galt, Sarnia, Woodstock, Paris, Preston, Walkerville, Wallaceburg, Seaforth, etc., is supplying power for manufacturing munitions of war, such as abrasives, aeroplanes, aluminum, beds, blankets, boots, brass sockets, brushes, camp ranges, carbide, castings, chemicals, clothing, cloth wire, cutlery, flour, fuses, harness, kit packs, primers, provisions, rifles, shells, shell parts, shell boxes, shell-making machinery, special lanterns, special steel plugs, special tools, wagons, etc.

The uses to which electrical energy in large quantities is applied in the electro-chemical industries are well described by a statement recently made by Mr. F. J. Tone, of the Carborundum Company, Niagara Falls, N.Y. He says:

"The part set for Niagara industries in the war program is a large one. They must supply the bulk of the ferro-alloys, the all-essential of the steel industry. Ferrochrome is wanted for armor plate and projectiles. The army must have chlorine for gas shells, camp sanitation, water purification, and for the Dakin solution. Explosive makers want caustic soda, potassium chlorate, and chloro-benzol. Dirigibles require silicon for generating hydrogen. Destroyers want phosphorus for smoke screens. Abrasives cyanides, aluminum, electrodes, and many other products are urgently needed in the war game. The Aircraft Production Board had decided on the design of the standardized United States aeroplane motor. It will require quantities of ferrochrome for chrome steel crank shafts, chrome steel connecting rods, and all parts subjected to the enormous strains of a mechanism weighing less than two pounds per horse-power. Quantities of aluminum will go into crankcases and pistons. The modern grinding wheel alone makes possible the finishing to limits of a fraction of a thousandth of an inch all parts of the aeroplane engine, and thus the artificial abrasives of Niagara become the key to interchangeability."

Munition Requirements

The munition plants being served with power by the municipalities and the commission from the Niagara system, in August, were taking a total of over 78,000 h.p. with firm contracts amounting to 94,600 h.p. Some of this power cannot be supplied without cutting off other customers. Additional present demands from the Union Carbide Company, the Electro Metals Company, and other munition manufacturers, total over 45,000 h.p. The Ontario Power Company, in August, for munitions and war materials, was supplying some 44,600 h.p. This makes a total demand upon the Hydro-Electric Power Commission and the Ontario Power Company for munitions of over 186,000 h.p. Of this, however, 30,000 to 35,000 h.p. may be considered as off-peak power, thus leaving a net power capacity required of some 150,000 to 155,000 h.p. The shortage on the Niagara system for munitions for the commission and the municipalities, considered by themselves, may be placed at about 65,000 h.p.

What are some of the means by which this shortage may be supplied?

1. Increased utilization of steam power. This, at the

present time, is out of the question as a means of dealing with the problem as a whole.

2. Supplying, temporarily, water from the unappropriated surplus, to permit the utilization of the excess capacity of the plants at Niagara. This, I understand, has been provided for.

3. Curtailment of the power now used for street and other lighting; also for certain power purposes, in order to liberate more power for manufacture of munitions.

4. Utilizing the water of existing plants under more efficient conditions, such as will exist in connection with the new Chippewa project, under a head of 300 to 305 feet. It will, however, be approximately three years before relief can be obtained by such means.

5. Limitation of the quantity of power at present being exported from Canada to the United States. Owing, however, to manufacturers of war munitions in the United States being, it is claimed, also short of power, the limitation of export will require very careful consideration in its international aspects.

Details Respecting Exportation of Electricity

Consideration of the curtailment of the export of electrical power from Niagara requires a critical examination of the underlying factors. Much has been said respecting the lessening of the quantity of electric power being exported from Canada to the United Stats, and a good deal of misunderstanding has arisen in this connection. The chairman of the Ontario Hydro-Electr c Commission has been urging the retention in Canada of a sufficient amount of Niagara power to assist in meeting the present exigencies. If the amount retained be such as will equalize the quantities actually utilized in each country, then instead of returning the total exported quantity of about 125,000 h.p. there would, under present circumstances of development, be only some 60,000 h.p. returnable. The figures presented below indicate, by way of illustration, a basis upon which an analysis of equity in advantages and disadvantages of present conditions at Niagara, per se, may be weighed:

Provisional Balancing of Power Generated at Niagara Falls on Both Sides of International Boundary

	Horse-power.
Total power generated at Niagara Falls on both sides of boundary	653,500
One-half of total amount of power generated is	326,750
Amount of power generated on United States side	265,000
Amount of Niagara power used in the United States	390,000

Thus, according to the figures above presented, the United States would be utilizing some 60,000 h.p. in excess of half of the total amount generated, and the retention of this in Canada would make the quantities used in both countries equal.

Canada is exporting electric energy from the Province of New Brunswick to the State of Maine; from the Province of Quebec to the State of New York; from the Province of Ontario to the State of New York and the State of Minnesota, and from the Province of British Columbia to the State ot Washington.

As pointed out a year ago, no country need be expected to send out of its borders that which is essential to its own existence. Having in mind the present coal situation, it is unnecessary to emphasize the vital importance to Canada of this national and international fuel and power question. Canadians should appreciate the fact that the United States has been dealing with them generously in the present distressing coal situation. Portions of the United States are as badly off for coal as portions of Canada. Between the United States and Canada there is exchange of many natural and manufactured products, and the problems which are sure to arise, from time to time, in connection with such interchange can be satisfactorily solved and the whole situation reduced to a good working basis. Canada, however, must by all means conserve against the day of her own need such resources as are available for barter. These problems call for the best statesmanship which Canada can bring to bear upon them. Only by a knowledge of all facts relating to the subject can a wise administrative policy respecting our fuel and power problems be formulated and carried out.

Discussion

Sir John Kennedy, in discussing the above paper, referred particularly to the difficulties of development on the St. Lawrence, the ice troubles, due to the fact that the river flows from the warmer to the colder areas, and consequently causes an early break-up of the ice and resultant high water. Sir John suggested the establishment of an international commission of engineers to develop a scheme for the utilization of St. Lawrence powers on the international section, on completion of which it could be handed over to a body similar to the International Joint Commission for administration. On the power being developed, if Canada did not require all her share of the power, it could be exported, but only upon such conditions as would be satisfactory to Canada, and upon short-term leases only.

Mr. R. A. Ross, C.E., of Montreal, in further reference to the paper by Mr. White, corroborated to a large extent the remarks of Sir John Kennedy. Referring to the utilization by electro-chemical works, he advocated the idea of a general survey of the water-power resources, and the allocation of certain powers for electro-chemical industries which would not likely be required for domestic or manufacturing power, the essential of a successful electro-chemical plant being a large amount of power at a low cost.

Montreal Builders' Exchange Plan Organization of French-Canadian Contractors

An effort is to be made to increase the French-Canadian members of the Montreal Builders' Exchange, and for that purpose the co-operation of French-Canadian firms who are already members is to be invited. Early next year a special general meeting is to be held to which French-Canadian contractors and supply houses will be invited. It is felt that there is a great opportunity for the two sections of the population to work in harmony in the interests of the building trade. Mr. J. P. Anglin, the President, speaking on this subject recently pointed out that French-Canadian sections of the various trades could be organized, and a fair number of members elected to the Board of Directors. The present time, when business was comparatively quiet in the various trades, seemed to be the time that their lines should be laid, to handle, in a manner satisfactory to all, the volume of trade that would follow the end of the war, and to deal comprehensively with the many difficulties that would then arise.

Concrete Ships Nearing Completion

Motion pictures of concrete shipbuilding are now being shown in the United States. These portray a concrete ship now being built on the Pacific Coast. This vessel is over 300 feet long and of nearly 5,000 tons capacity—little different from the ordinary steel ship except that while a steel ship of equal capacity would cost about $2,000,000, it is claimed that the concrete one will cost only $750,000. It is built in a manner very similar to that used in constructing reinforced concrete buildings. This is not the first concrete vessel on this continent, as there is one now already completed in Montreal by the Atlas Construction Company.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Rails Used Instead of Stringers to Carry Railroad Tracks Over Narrow Trenches

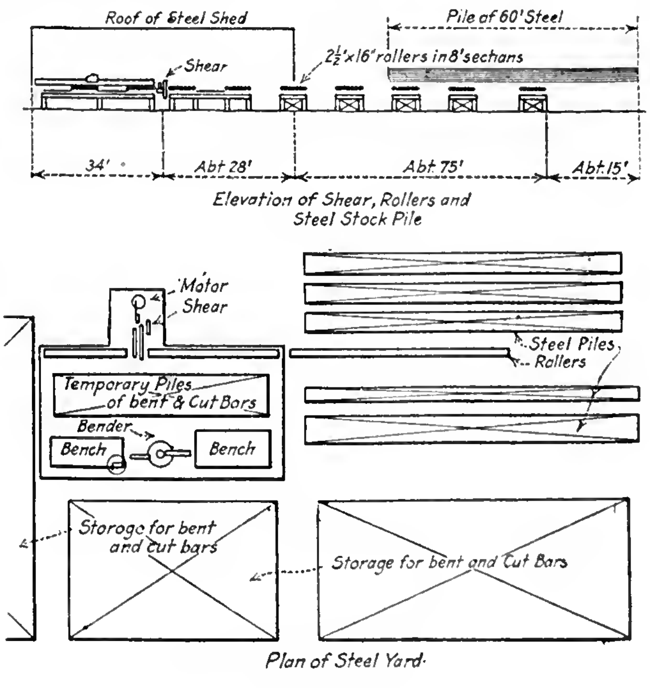
NARROW excavations, trenches, and the like under railroad tracks for pipe laying and other purposes can be made easily without the installation of track stringers by using, for each rail, a pair of ordinary track rails, longer than the width of the excavation, laid one on each side of the running rail and supporting four saddles that carry bearers passing under the running rail and supporting it over the center of the excavation. Ordinarily one pair per rail will suffice for an opening 3 feet wide and two for an opening 5 feet wide. The side rails should be beveled at the ends and are seated on the ties adjacent to the track rails. They are portable and convenient, quickly put in place and removed.

Roller Conveyors Handle Long Steel Bars from Shear to Stock Piles

SEVEN men handle 1 1/3-in. reinforcing bars 60 feet long from stockpile over lumber roller conveyors to cutting shears and then to storage piles supplying the steel for a five-storey addition to the plant of the Eastman Kodak Company, at Rochester, N. Y. The structure is 152 x 562 ft. in plan and requires 15,000 cubic yards of concrete. All the steel is cut on the job.

Tables, each consisting of a frame with rollers set in the top, are placed 8 or 9 feet apart in a line from the steel shear to the stock piles. There are 75 lin. ft. of 8-ft. roller sections used. Four men put the steel on the tables, and standing between the tables, push it forward toward the shears where three men cut it and pile the cut lengths.

Across the shed from the shear is a power bender which makes two bends at once on the truss bars for the beams. The bent and straight bars are tagged and the different types are stacked in separate piles in the storage space around the steel shed. The arrangement is illustrated in the sketch taken from Engineering News-Record.



Steel bars handled by rollers.

Points to Remember in Connection with Rubber Belts

NO one part of a belt should be subjected to undue strain; neither should a belt be run against the splice. Shift belts slowly and carefully with a shifting gear that will not damage the belt's edge.

Lagging pulleys with rubber-frictioned duck increase belt adhesion. Belts should be put on the pulleys at low speed only.

Never run the seam side of a belt next to the pulley as the other side is specially designed to take up the strain.

Lace-holes should be cut small, clean and round, not too close together nor too near end of belt; otherwise they are likely to pull out.

Keep driving surface clean. Avoid sticky dressing—it dries the rubber, causes peeling and forms lumps on the pulleys as well as on the belts.

When splicing or lacing belts, cut the ends absolutely square and true, and about ⅛ to ¼ of an inch—according to size of belt—to each foot shorter than the actual distance between and around pulleys.

It is bad practice to work a belt to its full capacity. A reasonable margin of safety should be allowed to take care of any extra strain to which the belt might be subjected in the course of its use. The more exacting the conditions the greater the margin necessary.

Flapping when running at high speed is due to air being trapped in between belt and pulley. To overcome this condition, bore a few small holes in the pulley. This will increase belt adhesion as will also holes in the pulley plugged with cork.

Never stand in front of a quickly-revolving pulley or main drive wheel at any time. Should the belt break, serious injury or death might result from the force of the blow.

Do not unnecessarily expose a belt to excessive heat—either artificial or that caused by friction—or injurious substances such as oils or greases. Many belts are damaged by oil leaking from bearings or being splashed on to them. Avoid vertical suspension of belting wherever possible.

Keep belting square in the centre of pulley, and see that the crown of pulley is not greater than ⅛ of an

* Contributed by Dunlop Tire and Rubber Goods Co., Ltd

inch per foot; otherwise, the centre of the belt has to bear unnecessary strain.

As a belt seeks the highest point of the pulley, and that highest point is the centre of the crowned pulley, "running-off" will be avoided. If not crowned, driving and driven pulleys must be exactly parallel, or uneven stretching will result, and "running-off" will be a common occurrence.

When new belts are put on old or badly-arranged pulleys or shafting, the use of idlers, to take up the slack, is preferable to the crossing of the belt, as the same result is secured with less injury. The best plan is to buy new pulleys and re-arrange the shafting.

Avoid crossing belts, however, wherever possible. Do not use belt tighteners or idlers unless absolutely necessary. Crossing belts tends to twist and strain them, and idlers and tighteners increase belting costs through extra wear. It is much wiser to arrange equipment in the first place so that the practice of crossing belts or using idlers or tighteners will not be necessary.

Should the belt slip, moisten it very lightly on the pulley side with boiled linseed oil. Slipping is caused by over-loading, the accumulation of dust, pulleys out of alignment, belts being too loose or drying up, and through general neglect. The possibility of a belt slipping decreases with age. It is more likely to slip when running at low speed than at high.

Provide pulleys of ample diameter and face to avoid abnormal stretch on the outside and compression on the inside, caused by the constant bending of the belt. The width, thickness and length of belt govern the size of the pulley. The heavier and thicker the belt, the larger the pulley should be.

When rubber belts are to be idle for any length of time, they should be dusted well with powdered soapstone, rolled up on a wooden core, and carefully wrapped in heavy canvas on which a generous supply of soapstone has also been sprinkled. The addition of a good dressing before supplying the soapstone keeps the belt pliable. The belt should then be stored in dark, dry and cool quarters. Light, heat and extremely dry air tend to rot rubber, while darkness and moisture preserve it. If the above method is carefully observed, when storing belts, shrinkage will be reduced to a minimum, and no deterioration should be apparent when the belt is again put into use.

Trade Publications

The Portland Cement Association has published a booklet entitled, "What the Press Says About Concrete Ships," containing bits of newspaper comment on this subject.

"Why Not More Concrete Tanks?" is the name of a pamphlet being distributed by the Portland Cement Association. It contains testimony from those who have had experience with concrete for tanks and standpipes.

C. S. C. E. Will Issue Steel Bridge Specifications

The Canadian Society of Civil Engineers' Committee on Steel Bridge Specifications will shortly issue complete specifications. The committee includes some of the most eminent engineers in this branch of the profession, and the specifications are the result of many meetings and suggestions.

Mainly Constructional

East and West—From Coast to Coast

During the present year there have been 126 buildings erected in the city of Winnipeg, Man., with a total value of $2,500,000.

The permits issued for the first eleven months of this year in Chatham, Ont., amount to $356,897, as compared with $292,709 for the corresponding period in 1916.

The new county bridge over Cedar Creek, west of Arner in the township of Colchester South, Ont., has been completed, the contract having been carried out by James McGill.

The building permits issued in St. John, N.B., for the eleven months of this year total $529,750, as compared with $462,350 for the corresponding period of 1916, a gain of $57,400.

A town-planning act has been brought up for the consideration of the Saskatchewan Legislature. Saskatchewan is the first of the western provinces to introduce such a measure.

The Ontario and Minnesota Power Company, Limited, have deposited with the Minister of Public Works, plans of a dyke which they propose to build in the Rainy River at Fort Frances, Ont.

The Graham Island Spruce and Cedar Company, Limited, have filed plans with the Minister of Public Works for a sawmill structure and other works which they propose to erect at Prince Clements, B.C.

A syndicate of Toronto capitalists propose to establish a new international ferry line between Detroit and Windsor, and the council of the latter city have granted them water-lot privileges at the foot of Brock Street.

The first freight train crossed the Quebec Bridge on December 3. The total weight of the train was 1,245 tons, and it was just the length of the central span. Regular service has now been established across the bridge.

At a meeting of the bondholders of the Ontario National Brick Company it was decided to provide means to take over the concern in liquidation in the interests of those who are willing to put in $250 new money for each $1,000 bond held.

Work was recently started by the contractor, W. M. Leacy, of Prescott, Ont., on the building of a subway at Lynn crossing near Brockville. It is his intention to excavate the rock this winter and the work will probably be completed early in the spring.

The building permits issued in Welland, Ont., during the month of November this year are valued at $14,150, as compared with $15,237 in the same month last year. The total for the eleven months of 1917 is $240,334, as against $191,362 during the corresponding period in 1916.

London, Ont., building permits for November this year number 68, and are valued at $85,010, as compared with $64,850 for the same month in 1916. The total for the eleven months of 1917 is 817 permits at a value of $803,300, while for the corresponding period last year there were 1,003 permits at a value of $907,420.

The Saskatchewan Co-operative Elevator Company will construct a new hospital elevator on the north end waterfront, Port Arthur, Ont., at a cost of $450,000. It is to be ready to handle the crop of 1918. The unloading capacity will be twelve cars per hour and shipping capacity to the boats 45,000 bushels per hour. The Canadian Northern elevator "B" is also to be rebuilt during the winter at a cost of $500,000.

The Grand Trunk Pacific will carry out the original plans for the erection of Hotel Qu'Appelle, at Regina, Sask., with the addition of accommodation in the basement for a passenger station provided that the consent of the local government board is obtained to transfer the guarantee on terminal bonds.

Twenty-two building permits were issued in Brantford, Ont., for the month of November, at a total value of $25,335, which is an increase of $15,390 over the same month last year. The total for the eleven months of the year is 323, valued at $137,280—a decrease of $139,622 from the corresponding period in 1916.

In the city of Vancouver there were 48 permits issued for the month of November valued at $35,075, as compared with 38 for the same month last year at a value of $100,695. The total for the eleven months of 1917 is 525 permits valued at $711,960, as against 415 for the corresponding period last year, at a value of $2,126,524.

It is understood that Mr. M. J. O'Brien contemplates the erection of a large industrial plant on the Malloch property at Arnprior, Ont., and also the development of water power on the Madawaska River. While no definite figures have been given out, it is reported that expenditure on this development may run upwards of three million dollars.

Messrs. J. Coughlan & Sons, who engaged in shipbuilding work some time ago, have deposited with the Minister of Public Works, plans of a wharf and four launching-ways which they propose to build at False Creek, Vancouver. They have recently closed a contract with the Imperial Munitions Board to build four 8,800-ton vessels at an estimated cost of about $1,250,000 each.

Since its formation in 1911, the York Highway Commission has expended $600,000 on a schedule of good roads covering 110 miles, according to the statement of Mr. Geo. S. Henry, M.P.P., in an address before the York Pioneers' Association in Toronto recently. Mr. Henry traced the growth and the development of the good roads movement in this country from the time of the French up to the present.

The Winnipeg municipal hospitals commission has requested the board of control that the necessary authority be obtained from the legislature allowing the city to submit a by-law to the ratepayers for the issue of debentures to cover the cost of an addition to the King Edward Hospital and the erection of a nurses' home. The amount required would be about $25,000 for the addition to the hospital and from $175,000 to $200,000 for the nurses' home.

Work was recently started on a new erecting shop for the Canada Machinery Corporation on Water Street South, Galt. P. H. Secord and Sons, of Brantford, have the contract for the brick and concrete work and the Hamilton Bridge Works for the steel construction. The new addition will cost over $30,000. It is 180 ft. by 140 ft. in dimension, part two storey and part one storey, of brick construction. The steel work is to accommodate a 25-ton travelling crane.

For the first eleven months of this year the value of the building permits issued in the city of Toronto is estimated at $6,793,098, as compared with $6,452,823 in the corresponding period in 1916. In November there were 351 permits issued at a value of $418,019, as compared with 398 permits valued at $948,026 in the same month last year. It should be pointed out that the total for November, 1916, was considerably increased by a permit issued in connection with the new Union Station.

The county council of Grey, Ont., recently carried a good roads by-law, covering some 53 different lines of roadway throughout the county. A resolution was also passed asking that the province take over the three main roads of the county, namely, the Garafraxa road, running north and south, the Toronto-Sydenham road, and the road running from Wiarton across Keppel to the lake shore road leading to Owen Sound, thence across the county to Meaford and along the shore to Thornbury and Collingwood.

Personals

Mr. A. M. Boivin, farmer and contractor at St. Francois-Xavier and Winnipeg, has been elected Conservative member of the Iberville, Manitoba, seat in the legislature by acclamation.

Mr. Clifford Price, superintendent of the works department of St. John, N.B., who recently underwent a serious operation, is now nearly recovered and will soon resume his duties.

Mr. Herbert Elgie and Mr. Geo. T. Gayton represented the Toronto Builders' Exchange at the Convention of the Master Mason Contractors 'Association of United States and Canada, held in Indianapolis on December 3, 4 and 5.

Mr. R. S. McConnell, of McConnell & McConnell, architects, Toronto, has joined the Royal Flying Corps and is now training at Camp Mohawk, Deseronto. Mr. McConnell graduated from the University of Toronto in 1915.

Corp. J. N. Williams, a graduate of the Faculty of Applied Science and Engineering of the University of Toronto, is reported wounded. Corp. Williams enlisted in March, 1915, and served with the 25th Battery at the front for several months.

Mr. L. P. Murray, formerly mid-western manager of S. F. Bowser & Company, Inc., manufacturers of gasoline storage tanks, has been appointed Canadian manager with jurisdiction over the Canadian office, factory and sales force. The Canadian activities have recently been under the direction of Mr. Harry Christie, who will now turn his attention entirely to the sales organization throughout Canada. The head office of the company for Canada is situated at 66 Fraser Avenue, Toronto.

Major A. G. Tweedie, who has returned home from the front after eighteen months in the trenches, has made application for the position of city engineer of Sault Ste. Marie, Ont., in the event of the present engineer, Mr. McFaul, being called to the colors under the Military Service Act. The council have fallen in with the suggestion, and if Mr. McFaul leaves, Major Tweedie will get the position, though there is an understanding that in case the former returns to the Sault wounded and unfit for further service to his country, he is to be reinstated. Major Tweedie is a fully qualified civil engineer of fifteen years standing and has his Bachelor of Science degree from the University of Edinburgh, Scotland.

Obituary

Capt. A. J. Latornell, B.A.Sc., formerly city engineer of Edmonton, Alta., is reported to have died of wounds.

Flight-Lieut. J. Nelson Cunningham, a graduate of the Faculty of Applied Science and Engineering of the University of Toronto, has been killed in action.

Major Gordon Powis, formerly the representative of the Canadian Westinghouse Company at Edmonton, Alta., has fallen in the recent fighting at Passchendaele. Major Powis was a B.Sc. of McGill University.

Chas. W. Dailey, who was connected with the early developments of the railroads in the Northwest, recently died of apoplexy at his home in Detroit. He was at one time associated with the late James J. Hill in St. Paul

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Amherst, N.S.
City Council contemplate purchase of 750 feet of 18-inch sewer pipe in connection with the construction of a sewer from Copp Ave. to Marsh Street.

Goderich, Ont.
The Town Council will construct sewers on Victoria St. and Britannia Road. Clerk, L. L. Know.

Maisonneuve, Que.
The construction of sidewalks costing $30,000 in the parish of St. Jean Baptiste de Lasalle is contemplated by the City Council. Secretary, Jos. Hinton.

City Council contemplate the construction of pavement costing $16,000 on Girard Street. Secretary, Jos. Hinton.

Renfrew, Ont.
Town Council contemplate the construction of an 8-inch sewer on Barr St. from Hill to Combs Streets. Engineer, J. H. Stewart.

Sarnia, Ont.
City Council contemplate asphalt resurfacing. Engineer, J. A. Baird.

St. Georges de Champlain, Que.
Plans are being prepared by the engineer, W. Bourassa, Grand'Mere, for $25,000 aqueduct for the Town Council.

St. Thomas, Ont.
City Council contemplate the construction of storm sewer costing $64,000. Engineer, J. A. Bell.

Sturgeon Falls, Ont.
Town Council contemplate the construction of sewers costing $5,000 on William Street.

Winnipeg, Man.
Tenders have been extended until noon, December 14, for reinforced concrete pipe line, etc., for the Greater Winnipeg Water District. Specifications at office of the chief engineer, W. G. Chace.

CONTRACTS AWARDED

St. Catharines, Ont.
McLaughlin Bros., care of engineer, Wm. P. Near, have the general contract for relief and outlet sewer costing $70,000 for the City Council.

York Township, Ont.
Orsiny & Co., Dufferin Street, Toronto, have the general contract for the construction of watermains on Lauder and Glenholme Aves.

Railroads, Bridges and Wharves

CONTRACTS AWARDED

Edmonton, Alta.
The Zenith Construction Co., 10116-102nd Street, have the general contract for reinforced concrete viaduct for the Swift Canadian Company, North Edmonton.

Public Buildings, Churches and Schools

Charlottetown, P.E.I.
C. B. Chappell & Hunter, Des Brisay Bldg., have prepared plans for interior work for St. Dunstan's Cathedral on St. George St. The Bishop, Rt. Rev. H. J. O'Leary, will call tenders for a large quantity of metal lathing, ornamental plastic work, etc.

Hamilton, Ont.
Hospital Board, City Council, contemplates fire-proofing hospital wing. Clerk, S. H. Kent.

London, Ont.
The Talbot St. Baptist Church contemplate remodelling choir loft at a cost of $9,000. Pastor, Rev. H. H. Bingham, 134 Maple Street.

Maisonneuve, Que.
The Department of Public Works, Dominion Government, contemplate the erection of a post office building. Secretary, R. C. Desrochers, Ottawa.

Montreal, Que.
Tenders will be called within a month for the erection of a $200,000 school for the Roman Catholic School Commission, 87 St. Catherine St. W. Architect, C. Bernier, 70 St. James St.

Mount Dennis, Ont.
Tenders will be called shortly for the erection of a brick addition to school for the School Board. School Section No. 22. Architects, Ellis & Ellis, Manning Chambers, Toronto.

Nobleford, Alta.
Tenders are being received addressed to the secretary, for the erection of a lodge hall for the Knights of Pythias.

North Wellshire, P.E.I.
Tenders will be called soon for plumbing, heating and electrical work for addition to "Dalton" sanitorium for the Military Hospitals Commission, 22 Vittoria Street, Ottawa.

Peace River, Alta.
Municipal Hospital Board contemplate the erection of a hospital. Clerk, R. M. Upton.

Quebec, Que.
L. Auger, St. John St., has prepared plans for a $500,000 public building for the Commission of Provincial Exposition, City Hall.

Renfrew, Ont.
The Victoria Hospital Board contemplate the erection of a hospital. Superintendent, Miss V. L. Pogue.

St. Anne de Bellevue, Que.
E. G. M. Cape & Co., Ltd., 10 Cathcart St., Montreal, general contractors for $2,000 hospital for the Military Hospitals Commission, Drummond Bldg., Montreal, will carry out the painting and let plumbing and heating. The owners will let electrical work.

CONTRACTS AWARDED

Brantford, Ont.
Chas. Taylor & Co., 42 Dalhousie St., have the plumbing contract for $6,500 extension to hall for the Salvation Army, 70 Darling Street.

Charlottetown, P.E.I.
P. H. Trainer, Kent St., has the painting and glazing contracts for soldiers' convalescent home for the Military Hospitals Commission, 22 Vittoria St., Ottawa. Tenders are being received for plumbing, heating and electrical work.

E. E. Parkman & Son, 13 Euston St., have the general contract and will buy material for nurses' home in connection with soldiers' convalescent home for the Military Hospitals Commission, 22 Vittoria St., Ottawa. The architects, C. B. Chappell & Hunter, Des Brisay Bldg., will call tenders shortly for plumbing, heating, painting and electrical work.

Cobourg, Ont.
The following contracts have been awarded in connection with the erection of a $35,000 school for the Public School Board:—General contract, masonry and roofing, M. Jex & Co., Division St.; carpentry, Henderson & Bros., First Ave.; electrical work, Geo. Lowe, Division St.; plumbing and heating, W. R. Whitelaw, King Street.

Montreal, Que.
Mariotti Marble Co., Provinciale Lane, have the marble contract for $75,000 addition to building at the corner of St. Gabrie and Notre Dame for thte Provincial Government, Quebec.

St. Catharines, Ont.
C. F. Monk, Wilson St., has the carpentry, and Newman Bros., 75 St. Paul St., the masonry contract for $30,000 church and Sunday school for the Niagara St. Methodist Church. Tenders will be called shortly for heating, plumbing, plastering and electrical work.

Ste. Perpetue, Que.
Thomas Caron, St. Aubert, has the general contract for church interior work for the Parish.

Sydney, N.S.
Spurr & Israel, 118 Union St., have the plastering contract for $53,000 school for the School Board.

Westmount, Que.
John McGregor, Ltd., 511 St. Catherine St. W., Montreal, have the general contract for $6,000 waiting room to be erected at St. Catherine St. and Lansdowne Ave., for the City Council.

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Principal Contents

Unity Among the Engineers of Canada and the United States

AN item in the Contract Record of December 5 announcing a proposed closer relationship between the American and Canadian Societies of Civil Engineers, suggests a matter that might well be advocated. This proposal for the more intimate co-operation of the two great representative bodies of engineers, initiated by the Board of Direction of the American Society, has been warmly welcomed and ratified by the council of the corresponding Canadian body. Briefly, the resolutions which were adopted aim to co-ordinate the two societies for their mutual benefit and advancement and to promote harmonious co-operation in the interests of the engineering profession.

In professed purpose, clientele, and professional requirements, the Canadian Society of Civil Engineers is almost identical to its American sister society. The same high standards of professional and personal conduct are upheld; similar requirements of practical engineering experience are desired, and similar methods of society operation are maintained. The members of the two societies have the same objects in view, perform the same kind of work, and are interested in the same ideas. Restrictions have not been made by one society to keep for its membership members of the other body, so that we see at the present time a considerable proportion of the clientele duplicated. In view of these similarities, then, there is every reason for a closer working in harmony of these two great bodies representative of the engineers of the United States and Canada.

In view, further, of the great struggle which now involves the republic, there are the greater ties of allied patriotism. We are all engineers second only to being patriots, and the spirit of loyalty that binds us to our country ties us also to those of our allies. Engineers are intensely and vitally interested in, and affected by, this Armageddon. In no previous conflict has the engineer had so important a role. The common cause that now unites the United States with Canada unites their engineers with ours, and makes imperative a more closely knit relationship.

It is, no doubt, this kinship in the great war that has impelled the American engineers to make overtures of co-operation. The crisis is drawing the allies together into closer relationship, and it is similarly drawing its engineers together. Even were not this more or less sentimental reason present, there is every argument for a greater display of good feeling and fellowship. The great profession needs a unifying force, and nothing can perhaps serve to supply this need more than a linking up in activity of the American Society of Civil Engineers and the Canadian Society of Civil Engineers. We hope that the mutual relations will be greatly improved as a result of the resolutions which have been adopted by the controlling authorities of the two bodies. May joint meetings bring them together that the profession may be unified and the whole brotherhood of engineers enlarged.

Co-operation and Standardization Will Reduce Building Costs

ONE of the most serious factors in the building situation is the high cost of labor and materials. People who might be willing to invest money in bricks and mortar are no doubt deterred by the extra cost, due to war conditions; they cannot see an adequate return on their outlay, and for this reason many projects have been postponed from time to time. The belief that costs generally will come down in the near future is probably without foundation, the chances being that even should peace come prices will continue on a high level for a long time. In Montreal, there is an insistent demand for flats and houses which has not been met, and it is with the view of reducing costs in the smaller class of buildings, and thus inducing people to build, that the Montreal Builders' Exchange have had under consideration the question of cheaper houses and the subject of building in general.

These questions have been brought to the attention of the members by Mr. J. P. Anglin, B.Sc., of Anglins, Limited, who will in the new year ask the Exchange to get right down to business by securing the co-operation of architects, supply men, contractors, etc. Co-operation and standardization of certain classes of buildings are the means advocated by Mr. Anglin. "Co-operation," he said, to a representative of the

Contract Record, "is the keynote of the question. I believe in men in the same line of business getting together. Also I believe that something can be done in the direction of reducing costs, and I am anxious that we should co-operate towards this end. My ideas would apply more to the larger cities; in the smaller towns a man is not so restricted as in the cities. In the latter the restrictions have been growing more severe, and naturally these add to the cost of building.

"I would like to see some of the non-essential restrictions removed, provided, of course, that the safety of the public and adjoining owners be guarded. This would give a man more leeway, provided that he lived up to the essential restrictions. It is evident that every amount of material saved will lower the cost of building. My remarks only apply to the smaller class of buildings, flats, etc. You cannot reduce the restrictions on large structures to any extent, nor would it be wise to do so. We should study the situation, and see how we can reduce the quantity of materials in the average house.

"Another way is to build more according to a standard. Take the case of windows—a very appreciable item. You will hardly get two people to select windows alike. If a standardized window, designed to use a smaller quantity of lumber, were adopted by architects and builders it would mean a considerable saving of material. As to double windows in places where the climatic conditions are severe, I believe that it would be far better if they were not used in the majority of rooms—a single sash and single glass is all that is necessary for the average house. Wooden shutters in the summer time in Montreal could also be dispensed with, having regard to the short summer. A roller blind is sufficient protection from the heat. In the interior of the houses, the size of the mouldings could be reduced. Double floors are another item that could be done away with; let us go back to the old method of single floors. In this way we could work out a standard that would be cheaper all round.

"In Montreal there are municipalities that have changed the by-laws since the war, adding $200 to $500 to the cost of a house. I should like to see builders, architects, supply houses, mill men, etc., get together and go through the various items to see where possible savings can be made.

"As to the question of building at once, I see no prospect of any change in the situation in the direction of material becoming more abundant, and I also see no object in postponing building until after the war. The demand for material will probably become more acute, and this demand will be strong all over the world. The labor situation, too, will not, in my opinion, improve, and I therefore believe that now is the right time to build."

Reconstructing Halifax

A REPAIRS and construction committee has been appointed in Halifax, which has complete charge of all repair and reconstruction work in the city. Col. R. S. Lowe, the builder of Valcartier Camp and Borden Camp, has been appointed manager, and Mr. Hamilton Lindsay, president of the Nova Scotia Construction Company, assistant manager.

Building material of all kinds, including lumber, putty, glass, and a locomotive crane, have been sent to Halifax from Montreal. The Builders' Exchange, at a special meeting of directors, presided over by Mr. J. P. Anglin, decided to send the following message:

"The Builders' Exchange of Montreal, comprising the general contracting and building supply companies of this city, beg to offer their collective resources in aid of the reconstruction of Halifax by securing superintendents, time-keepers, and other labor, all building material, and especially sashes, doors, and ready roofing, and otherwise acting as your agents in Montreal."

The president pointed out that the members were anxious to do all they could to assist in relieving the situation; profits in a case such as this would not be looked for; the least that the members would wish to do was to place their organization and equipment at the disposal of the Minister of Public Works, the Mayor of Halifax, and the Chairman of the Reconstruction Committee.

The subject was further discussed at a special meeting of the members. The question of the offers of contractors outside the country to clear and rebuild the city was also considered, and a resolution was passed expressing the opinion that there are enough large and efficient contracting firms, with plants, labor, and materials, in Eastern Canada to take care of all the immediate and future requirements of Halifax; that these are available immediately, owing to the scarcity of building business; and that the firms can carry out the work of reconstruction at as low a cost as outside firms. The resolution concluded:

"The Builders' Exchange appreciate the offers of assistance made by outside contracting firms, but do not believe their employment is necessary or advisable."

The question of sending representatives of the exchange to get into touch with the authorities and report on the whole situation is under consideration.

After-the-War Houses

THE "new house" after the war, if designed on the lines recommended in an interim report by the Technical Conference set up by the British National Housing and Town Planning Council, should be a great improvement on that which exists to-day. The Conference is satisfied that if the 300,000 new houses suggested are erected in the year after the war the building trade will be greatly taxed, and they say it will be necessary for the occupants to pay higher rents.

They recommend that the houses should be broad rather than deep, in order to give ample light, that three bedrooms and a parlor should be provided, and that each house should have a bath, with provision for hot water supply. They also recommend that women should be called in to give assistance in regard to details of interior construction, such as stairs, cupboards, larders, and storage accommodation.

Schemes must not be carried into effect under the old conditions of layout. The number of houses per acre in urban schemes should not exceed ten and in rural planning gardens of not less than one-eighth of an acre should be provided.

While members of the conference are opposed to the standardization of houses, they are convinced that the possibilities of the standardization of component parts are very great.

Mr. P. L. W. Dupre, architect, has removed from 567 Delorimier Avenue, Montreal, to 15 St. Lawrence Boulevard.

What the Province of Quebec Has Done In Road Work During 1917

New Feature is Branch for Maintenance of Macadam and Gravel Roads—Inducements Offered by Province for Road Construction

By B. Michaud*

OUR work during 1917 was seriously handicapped by rain, which, in certain cases was diluvial, and not only interfered with the work under way, but destroyed bridges, fills, etc. This occurred mainly in the district of Beauce, along the Chaudiere River. Some other scattered places in the province were also visited by floods, but with less important damage. However, we succeeded in carrying out the improvement of several roads, as will be shown hereafter.

Montreal-Quebec Road at Ste. Foy. Asphaltic concrete surface laid in 1917 by Quebec Department of Roads.

Maintenance

A new feature of our organization is a branch for the maintenance of macadamized and gravelled roads. This work has been carried out with great care and activity and has given good results. We gave instructions to 189 municipalities for repair and maintenance work. This was done according to the special Act passed at the last session. The same Act provides also for the maintenance of the provincial roads, which was done under the supervision of a superintendent, assisted by patrol men. The provincial roads thus maintained are the Montreal-Quebec road, 180 miles; the King-Edward road, 39 miles; the Chambly road, 15 miles; the Sherbrooke-Derby Line road, 33 miles, and the Levis-Jackman road, 90 miles. Each patrol man has to take care of an average of about 30 miles. It has been a very hard task for all of them, on account of the bad weather which obtained during the whole season.

New Construction

By the municipalities, 71.70 miles of macadam and 78.93 miles of gravelled roads have been built. The Department of Roads has built for the benefit of the military people, motoring between Quebec and Valcartier camp, about 2 miles of gravelled road. Another mile of gravelled road has been built under our direction, for the benefit of the Imperial Munitions Board.

A new stretch of 9.8 miles has been added to the Montreal-Quebec road, between St. Augustin and the western limit of the city of Quebec. It will be covered with asphaltic concrete; 1.1 mile has been laid out this year and we expect the balance to be done next summer.

The Montreal-Quebec road, which is nearly all water-bound macadam, will be covered, where found necessary, with an asphaltic carpet coat. A stretch of about 13 miles has been treated that way this year, while stone chips and sand have been brought in place and distributed ready for resumption of work, on about 19 miles.

Province Offers Inducement

A new provincial road is under construction. It is a gravelled road of 25 miles between Three Rivers, Shawinigan and Grand'Mere. Nearly all the preliminary work has been done during the last season, and the top course will be placed next year. This is probably the last of the provincial roads to be built by the government. Now that an example has been set for the province, it will be left to the initiative of the municipalities to unite together and secure money from the government to build trunk roads. In fact, several of them have already taken that course and we expect, within two or three years, perhaps less, trunk roads to be completely built between Levis and St. Lambert, Co. Chambly, between Levis and Fraserville, between Beauce Junction, Robertsonville, Thetford Mines and Sherbrooke, between Beauceville and Sherbrooke via Lambton, between St. Alexis and Jonquieres, in the district of Chicoutimi. To the muni-

Bridge at Donnacona on the Montreal-Quebec Road. Span, 155 feet between main piers; elevation 50 feet above high water level

*Deputy Minister of Highways, Quebec.

cipalities thus showing their desire to follow our trunk roads policy, we give all possible facilities; we either grant them money at 3 per cent. to cover the whole of construction, or we grant subventions equal to the half of the cost of construction. In all these cases, as usual, specifications are prepared by the Department of Roads, and a close supervision exercised over the work.

The total length of macadam or gravelled roads in the province of Quebec, including municipal and provincial roads, is now 2238.35 miles.

Five Million Dollar Nickel Refinery

Plant of International Nickel Company at Port Colborne, Ontario—Activated Sludge Sewage Disposal—Highest Chimneys in America

THE site of the new refinery of the International Nickel Company, under construction at Port Colborne, Ont., consists of approximately three hundred and fifty acres, with a frontage immediately adjoining the Lake Erie frontage of the Canadian Furnace Company. The location is somewhat to the eastward of the entrance to the Welland Canal. The cost of the plant is estimated to exceed five million dollars, and there are over a thousand men still engaged on construction which will, it is hoped, be completed in the course of a few months.

Transportation facilities for the refinery will be provided by direct connection with the Grand Trunk Railway, a branch line of which passes the northern boundary of the refinery site. The position of the site with respect to the Welland Canal is such that recourse may also be had to transportation by water for those commodities that will be utilized in the refinery in large quantities, such as coal and coke, and where, owing to their points of origin, such water transportation may be deemed advisable.

Panoramic view of International Nickel Company's development.

Construction Quantities

There are in all thirty-one buildings of steel and brick construction. The following quantities represent some of the salient features in connection with construction:

Earth excavation	cu. yds.	96,210
Rock excavation	"	4,120
Peat removal	"	40,270
Filling and grading site	"	270,300
Concrete	"	25,880
Reinforcing	lbs.	1,312,900
Common brick	"	8,720,000
Fire brick	"	319,000
Steel work, structural	"	9,610,000
Cast iron	"	699,400
Roof area, asbestos	sq. ft.	332,800
Roof area, corrugated iron	sq. ft.	34,100
Roof area, slate	"	17,100
Doors	"	24,940
Windows	"	83,660
Lumber	ft. B.M.	4,760,000
Electric conduits	ft.	23,860
Plastering	sq. ft.	232,500
Terra cotta	sq. ft.	41,820
Rails	lbs.	1,740,000

An interesting feature of the plant is the construction of two concrete chimneys, three hundred and fifty feet high, and twelve feet in diameter at the smallest part. These are believed to be the highest reinforced concrete chimneys in America.

Activated Sludge Sewage Disposal

Another feature of the plant is the provision of two club houses for employees, and the installation of a complete water-borne sewage scheme, the treatment being by the activated sludge process. This type of treatment has been the subject of experiment both on this continent and in England for the past three years, and has now been developed to such a degree that the International Nickel Company decided to use the process, it being highly recommended by the Provincial Board of Health of Ontario.

The site was decided upon in October of last year, and active construction on the ground commenced immediately, and has been continued without interruption. The basis of the layout of the refinery provides for buildings so placed that various stages of the process are segregated and the economical handling of the labor and materials is obtained, liberal allowance being given to allow for future extensions.

Special attention has been given to lighting and ventilation, and up-to-date change houses fitted with shower baths and other facilities are available for the employees.

Problems in Industrial Housing

Constructional and Architectural Features of Houses for Industrial Townsites — Practical Needs Must be Considered

By Leslie H. Allen*

DURING the past two or three years employers of labor in all of our big industrial centres have experienced such great difficulty in getting and keeping employees that much attention has been focused upon the employment situation. The results of many investigations have shown that one of the prime causes for the shifting population and large labor turnover of many industrial plants is the utterly inadequate housing accommodations available for the industrial worker.

In years gone by wages were low and the cost of turnover was hardly considered, for there was always a long line of new men waiting for a job, and, because of this excess of supply of men over demand, a man was not so ready to throw up his job and seek another. He would put up with housing conditions for the sake of having any job at all. But in the present labor situation, with demand far exceeding the supply, the workman will no longer be content with the disgraceful housing conditions he has had to put up with.

The Effect of Present Crisis

Very little is being done at the present time to remedy this state of affairs, owing to the fact that the present abnormal prices of labor and building materials have shut off the supply of houses. Heretofore the demand for houses has been supplied by the speculative builder and the real estate operator. But at the present time he can no longer afford to build; in many cities he cannot get construction loans, and, even if he does, he cannot hope to sell in the open market at present prices, and cannot be sure of any return on his money by renting, having in mind a possible trade depression during the reconstruction period which will come at the end of the war, so that, while the demand for better houses continues, the supply is getting less and less. In view of the probability that the labor situation will not change for four or five years after the close of the war, the manufacturer is faced with the very serious problem of how best to compete in the labor market for his needs, with the knowledge that housing is an important factor in which he will get no help from local investors, as in former years.

He has long felt that the housing problem is one to which he ought to give serious attention. He has disliked doing so, and for good reason but the present crisis is forcing upon him the conviction that he has got to tackle it, and that in the future he ought to control it.

The Effect of Bad Housing on Industry

Apart from any consideration of this subject from the humanitarian or sentimental side, the industrial employer is beginning to realize the tremendous importance of these conditions in their relation to production.

He is finding out that men who are housed in unhygienic and unsanitary dwellings are not so healthy, not so efficient, lose more time through sickness, and are more stupid and troublesome in the plant. The output of a plant is seriously affected by the prevalence of sickness which is so often caused by the unsanitary surroundings of the workman's house and the overcrowding inside.

The interest of the employer in the health of the employee is being shown in better sanitary accommodations in the factory, the provision of drinking-water fountains, shower-baths, rest rooms, and hospitals, and in recreation parks and club rooms, athletic associations, etc., and in some cases in the sale of wholesome food for the workers to eat during their dinner hour. And in so doing he has recognized the importance to his plant of happy, healthy employees. The provision of decent houses for them is but a short step further.

The human tool is not unlike the machine tool in this respect—that the better it is housed and cared for the greater will be its efficiency and its output.

And so it is that we find in city after city and in many rural communities industrial plants are putting out large sums of money in building model villages or model homes for their working people. It is being recognized that in order to secure good workmen and to hold them it is necessary not only to provide work for them to do but to provide good houses for them to live in. It is no longer safe or good policy to leave this matter to chance or to the irresponsible real estate speculator.

The Building Problem

When the manufacturer has decided to build, he is faced with the problem of selecting the type of house he shall build, its size, number of rooms, materials of construction, amount of land per house, and so on. On these subjects there are as many differences of opinion as there are experts studying them.

It is unfortunately true that many developments have fallen far short of the hopes of their planners because too much stress was laid on unpractical ideals and less important features so that housing planned for the workingman proved unsuitable for him.

In order to arrive at some working basis to govern the laying out of new work, it will be well at this point to consider the essential needs of a workman's family in the light of present-day needs.

It must first be recognized that we have two classes of workmen to be considered: (1) The unskilled workmen, mostly foreigners or negroes, uneducated, unused to our own standards of living, earning a very low wage; and (2) the skilled men, mechanics, machinists, etc., earning a higher wage, living according to our standards, demanding more and willing to pay more for the comforts that the foreigner does not consider essential. The result of a failure to distinguish these two classes is that at the present time nearly all the houses built are houses for skilled workmen, and the need for better houses for unskilled labor has remained unsatisfied, resulting in overcrowding getting worse and worse.

The various types of houses now in use are as follows:

(A) Single houses of five to seven rooms.
(B) Two-family houses of four to seven rooms.
(C) Terrace or row houses of four rooms and up.

* Of Aberthaw Construction Company.

(D) Apartment houses or tenements, two rooms and up.

(E) Boarding houses for single men.

(F) Hotels.

The single house is the ideal residence for the American family, but is beyond the means of the low-paid, unskilled workman. A single house with five or six rooms with 3,000 feet of land cannot be built for less than $3,000, except in the cheapest kind of frame construction, and even at this price it would call for a higher rental than he can afford to pay. For higher-paid men in the plant the single house is very desirable.

The two-family house is often built for workers who wish to purchase their home. Though not suitable for the unskilled worker, they are quite attractive to higher-paid men who like to buy a two-family house so that the rental received from one-half of the house will help to pay the carrying charges and amortization of the whole house. In some cases these are built side by side with a party wall, and in some cases one tenement is built above the other. The first-named is preferable, as there is more privacy.

One of the most successful houses for the unskilled worker is that known as the "Philadelphia" type of house, of which many thousands have been built in Philadelphia, Washington, and other large cities. The typical four-room Philadelphia house is two rooms deep, and has a living-room and kitchen downstairs, two bedrooms and bath upstairs. It is built in long rows or terraces, with party walls in between. These can be built on as narrow a frontage as 13 ft. 6 in. (a 15 ft. frontage is desirable), on a lot of 900 square feet. The cost of both land and building is much lower than the preceding type. Houses built when prices were normal have been rented for as low as $12 a month, and have shown a fair profit.

The building of houses in terraces is comparatively new in this country, although it is very common in European countries. It allows for a very little land per house unless the lots are very deep, but is desirable in many other ways. Each family has a direct entrance from the street, without any common hallway, and is not interfered with by other tenants overhead. The cost of heating the house is less owing to there being fewer outside walls. In a house two rooms deep each room has a proper amount of light and ventialtion, and these houses have proved very successful wherever they have been used.

A recent variation of this type is the three-room two-family terrace house, with one family on each floor. These are generally in demand by married couples without children.

The multiple dwelling or tenement house, housing from ten to fifty or more families, is undesirable from many points of view, and yet in crowded cities, where land values are high, is practically the only solution.

Apartments of all sizes can be provided, the most common arrangements being three rooms (kitchen, living-room, and bedroom) or four rooms (kitchen, living-room, and two-bedrooms). Each apartment should have its own private toilet and its own water supply.

Although city laws do not in every case require it, multiple dwellings ought in every case to have fireproof stairways and fireproof cellars, and care should be taken to see that every room and also the halls and stairs are properly lighted. In English cities the stairs are often built outside the building, and each apartment is approached from balconies.

The industrial manager at this point may well stop in bewilderment not knowing how to proceed next, what size and type of house he needs to choose from this list being quite a puzzle. On this point it is impossible for any expert to offer advice until his local needs are accurately determined, and to do this the only safe way is to institute a careful survey of the housing conditions and needs of his locality. It is difficult to persuade him to do this, as each man thinks he knows just what his present conditions and needs are, whereas, in point of fact, his guesses are often wide of the mark. The first and only impulse of many men is to build as many six-room houses as he can, adding, perhaps, a few seven and eight-room houses for good measure. Until he knows the number of married couples without children he does not know how many small houses or apartments are needed. If he doesn't know the number of unattached single men he doesn't know how many lodgers must be taken care of, and unless he has facts before him as to the present habits and environments of those men he doesn't know whether in his town the lodger evil is the moral and social menace that the social reformer alleges it to be. He must know, too, the size of the different families with children, whether they are properly housed at present, and must have some facts before him on birth rates, death rates, sickness, and infant mortality, etc., compared with other cities, before he can be sure that his town needs improvement and what improvement it needs.

The only way of getting these facts is by a careful survey by an expert at this sort of work.

Materials of Construction

Very little change has been made in recent years in construction methods and materials, the chief alteration being towards the reduction of fire risks and conflagration hazards.

The standard form of wall construction for rural districts continues to be wooden framing. Where city laws do not forbid it, this is used in the cities. The frame is usually lathed and plastered inside and covered with rough boarding, paper and shingles or clapboards outside. Cement stucco on wire lath is coming into vogue for exterior finish—at a slightly higher cost; this when put on satisfactorily requires less maintenance and no repainting, but requires expert workmanship to make a satisfactory job. In a few cities brick walls are more frequently used, furred on the inside and lathed and plastered. A few houses here and there have been built with hollow tile, stuccoed outside and plastered inside directly on the tile; and some experiments have been made in concrete houses, although nowhere yet has Edison's dream been realized.

Comparative Cost Data

Although no exact cost data can be given at the present time on the foregoing material, the following figures are, however, given in order to indicate the relative costs of these materials based on present prices. As prices do not vary consistently, these figures may not hold good for very long. In certain localities where clay for tile-making is abundant the prices of tile would be cheap, and would indicate that this is the cheapest material to use. In other places where there is a good gravel supply right on the ground the relative cost of concrete would be reduced.

Assuming the cheapest construction, a wood framing, wood lathed and plastered on the inside and rough boarded and shingled on the outside, as our standard, or 100 per cent., the relative costs of various houses would be as follows:

	Per cent.
Wood framing, inside wood lathed and plastered, outside rough boarded and clapboarded and painted	102
Wood framing, inside wood lathed and plastered, outside wire lathed and stuccoed	108½
6 in. concrete wall, inside furred and lathed and plastered, outside rubbed smooth	112
6 in. concrete wall, inside furred and lathed and plastered, outside stuccoed	116
8 in. hollow tile, inside plastered direct, outside stuccoed	111
8 in. brick wall, inside furred and lathed and plastered	115½
Wood framing, veneered with 4 in. brick, inside lathed and plastered	113

The chief roofing materials in use at the present time are wood shingles, asphalted felt shingles, asbestos shingles, slate, tile, "ready" roofings, tar and gravel built-up roofings, and tin roofings, the last three being used for flat roofs.

The cedar shingle, while still in common use, is slowly giving place to other materials. Many cities have legislated against it, and as the asphalted felt shingle, which is a good deal more fireproof, can be put on for about the same price, it is coming into general use. The cedar shingle is a dangerous fire risk, on account of the ease with which conflagrations spread by burning shingles flying through the air.

The asbestos shingle costs about twice as much, and is not so commonly used, although it makes a more permanent roofing.

The cost of tile and slate roofing is so much higher than the above that they have to be left out of consideration in workmen's houses.

Flat Roofs

The flat roof covered with a five ply built-up tar and gravel roofing is considerably cheaper than any of the preceding, but its appearance is generally objected to. In our large cities it is used extensively, and, on account of the low first cost and maintenance expense, it is very favorably regarded. Various types of ready roofing are used as substitutes for built-up roofs, but, on account of the difficulty in making good water-tight joints, they have not come into general favor. The tin covered roof is being used less and less. It is more expensive than the built-up roof and requires frequent repainting and maintenance. One of the stock objections to the flat roof is that it is hot, but, as a matter of fact, this is not the case. The flat roof should have underneath it a ceiling furred down to give a hollow space of at least 18 inches between the ceiling and the roof surface. This dead air space provides a proper insulation against heat and cold, and is actually cooler in summer and warmer in winter than a pitched roof in which the ceilings of the bedrooms are sloping.

The objection to the flat roof on account of its lack of architectural pretensions is not an insuperable one. Conditions of this sort should be a challenge to architects to overcome.

Wood lath and plastering continue to be the customary method of finishing walls and ceilings. Plaster board covered with a finish coat costs very little more, and, where speed is essential, can be put on and dried out much more quickly. The various wall boards and composition boards offered as substitutes for plastering are not satisfactory for industrial houses. The cost per square foot is low, but the waste in cutting is very great unless specially ordered, and the result is not so permanent.

Interior woodwork is best stained and varnished and not painted, as it is less easily soiled.

Wall papers add nothing to the comfort or health of the tenant, but do add to the rent he has to pay, besides proving a harborage for vermin. Kitchen and bathroom walls are best painted with lead and oil, while many owners leave all other rooms bare or tint them with cold-water paint.

Architectural Design

In attempting to discuss architectural design we are treading upon difficult ground. No laws or limitations as to style can be laid down, and matters of taste cannot be discussed here. The designer of the workman's house is usually working under very strict limits of cost. It is his duty first of all to plan for the comfort, safety, and health of the tenant, and if after this is done he has still some money left for architectural adornment, the money spent in this way is money well spent.

Any attempt to beautify the elevation has to be paid for. Each dormer, every valley, each moulding, porch or railing has to be reckoned up in dollars, and where it becomes a question of sacrificing necessary floor space or internal convenience for outside embellishments, the tenant's vote, if he were given a chance to exercise it, would almost invariably be for the internal necessaries rather than the external luxuries.

In planning a house the square plan, bounded by straight lines, is the cheapest and most economical. As the plan changes from square to oblong, the ratio of walls to floor space increases, and with it the cost. Any departure from the right angle means increased labor and waste of material in cutting.

Porches should be so designed that they do not shut off sunlight from any room. In many row houses a continuous porch is built right across the front, with the result that sunlight never enters the front room on the ground floor. As sunlight is the greatest foe of disease germs, it will be seen what a detriment this is to the health of the inmate.

Valleys and dormers in a roof not only add to its cost, but to its maintenance, as these angles in the roof are the points where leaks first make their appearance.

No applied architectural ornament can equal the beauty or permanence of a careful planting of trees, shrubs, and vines. The plainest of houses suitably planted with quick-growing vines on permanent trellises, and with a good shade tree in front, will look far better than the most ornate building elevation and cost much less. In studying photographs of successful housing developments it will be seen that those which win the most general approval are those in which this feature has been given careful attention.

Benefit of Large Scale Operations

Until quite recently small house construction has been entirely in the hands of the local builder, operating on a small scale. During the past year, however, with the institution of several large housing developments in which speed of construction and durability of workmanship were important essentials, large contracting organizations have taken up this class of work, so that the manufacturer can now get the same kind of service in his house construction as he has been accustomed to get in his plant construction contracts. A good deal of economy is always gained when a large number of houses are built at one time by one contractor. The money saved by purchasing direct from manufacturing firms in carload lots rather than in team-loads from a local dealer, the continuous employment of large gangs of men, the taking of cash discounts, and other economies practised by big contracting organizations are quite a help in reducing costs.

When the whole development is under the control of one responsible contractor the disappointments so often experienced of houses built but roads not finished or sewers not completed are avoided. The grade of workmanship is better and the work is finished promptly instead of being allowed to drag far beyond the scheduled contract time.

What Toronto is Paying for Its 1918 Supplies

THE city of Toronto has recently awarded contracts for the annual supplies required for the works and other civic departments during the year 1918. The following lists give an indication of the prices that are current for various municipal supplies and represent those being paid by the city of Toronto. The lowest tenders are in each case quoted, as these were the accepted ones:—

Stop Valves.—3-inch, with sockets, each $21.60; 3-inch, with flanges, $21.60; 4-inch, with sockets, $25.50; 4-inch, with flanges, $25.50; 6-inch, with sockets, $31.85; 6-inch, with flanges, $31.85; 8-inch, with sockets, $46.25; 8-inch, with flanges, $46.25; 12-inch, with sockets, $78.25; 12-inch, with flanges, $78.25.

Lead Pipe.—3/8-inch, per 100 lbs., $14.00; 1/2-inch, per 100 lbs., $14.00; 5/8-inch, per 100 lbs., $14.00; 3/4-inch, per 100 lbs., $14.00; 1-inch, per 100 lbs., $14.00.

Mineral Dust or Filler.—Mineral dust or filler, f.o.b. C. P. R., Toronto, per net ton, $5.25; allowance for bags returned, each 10c. Contract awarded to Crushed Stone, Limited.

Brass Work for House Services.—Couplings, 1/2-inch, each, 56c.; 5/8-inch, 79c.; 3/4-inch, 95c.; 1-inch, $1.26. Stop cocks, single:—1/2-inch, each $1.01; 5/8-inch, $1.22; 3/4-inch, $1.70; 1-inch, $2.51. Lead to iron pipe couplings:—1/2-inch, each, 35c.; 3/4-inch, 61c.; 1-inch, 81c. Tail pieces:—1/2-inch to 3/8-inch, 09c; 3/8-in. to 1/2-in., 12c. Corporation cocks, single-threaded:—1/2-inch, 63c; 5/8-inch, 84c; 3/4-inch, $1.01; 1-inch, $1.50; 1 1/2-inch, $3.01.

Contract awarded to the H. Mueller Manufacturing Company, Limited, Sarnia.

Sand.—On dock foot of Princess Street, per ton, $1.05; car delivery, f.o.b. cars, Toronto, $1.00. Asphalt sand, car delivery, f.o.b. cars, Toronto, $1.00; on dock, foot of Princess Street, per ton, $1.05.

Sewer Brick.—Rectangular brick, team delivery, District No. 1, all east of Don, per 1,000, $15.00; District No. 2, between Don and Bathurst Street, per 1,000, $15.00; District No. 3, all west of Bathurst Street, per 1,000, $14.00. Car delivery, f.o.b. cars, C. P. R., per 1,000, $13.50; f.o.b. cars, G. T. R., per 1,000, $13.00.

Arch Brick.—Team delivery, District No. 1, all east of Don, per 1,000, $15.00; District No. 2, between Don and Bathurst Street, per 1,000, $15.00; District No. 3, all west of Bathurst Street, per 1,000, $14.00. Car delivery, f.o.b. cars, C. P. R., per 1,000, $13.50; f.o.b. cars, G. T. R., per 1,000, $13.00.

Contract awarded to the Dominion Sewer Pipe Company, Limited.

Brass and Bronze Castings, etc.—Phosphor bronze, per lb., 40c; Tobin bronze, per lb., 37c; brass castings, per lb., 35c.

Vitrified Paving Blocks.—No. 1 Lug Vitrified Paving Blocks, 3-in., f.o.b. cars, Toronto, per 1,000, $38.46; No. 1 Lug Vitrified Paving Blocks, 4-inch, f.o.b. cars, Toronto, per 1,000, $41.25.

Cast Iron Pipes.—3-inch, per length, $7.60; 4-inch, $8.40; 6-inch, $13.40; 8-inch, $18.09; 10-inch, $25.46; 12-inch, $34.50.

Contract awarded to the National Iron Works, Ltd.

Refined Asphalt.—F.o.b. Toronto, tank cars, C.P.R. sidings, per ton of 2,000 lbs., $22.00; in wooden barrels, per ton of 2,000 lbs., $26.00. Percentage of tare allowance: Wooden barrels, 6 per cent.

Contract awarded to the Imperial Oil Co., Ltd.

Bleach.—Car load delivery, f.o.b. Toronto in drums, per 100 lbs., $2.75; team delivery, in drums, Main Pumping Station, per 100 lbs., $2.75; Chlorinating plant, Wilton Avenue, per 100 lbs., $2.75; Chlorinating plant, Eastern Avenue, per 100 lbs., $2.75; Sewage Disposal Plant, per 100 lbs., $2.75. Any other point within city limits, per 100 lbs., $2.75.

Portland Cement.—In bags of 87 1/2 lbs. each, four bags per barrel net (350 lbs.), per barrel, $2.45; bags returnable, each, 10c; discount for prompt payment, per barrel, 5c.

Trap Rock.—F.o.b. cars on siding, per ton, 3/8-inch hard approved broken trap rock, $2.70; 3/4-inch, $2.70; 1-inch, $2.60; 2-inch, $2.05.

Believes in Classifying Asphalts

Editor, Contract Record:

In your issue of November 28th you publish a letter from Mr. Mullen disputing some of the arguments made by Mr. C. N. Forrest, Manager of the Technical Department of the Barber Asphalt Paving Company, in behalf of the change of the A.S.M.I. specification. Briefly, Mr. Forrest proposed that the requirements of this specification insofar as they refer to asphalt should be classified, one description covering native asphalt and the other oil or manufactured asphalt.

After presenting a number of arguments to show that Mr. Forrest's proposals should not be adopted, Mr. Mullen concludes: "specifications of the blanket type are always unsatisfactory at the best, but why differentiate along the lines of native and oil asphalt?"

Since Mr. Mullen in this sentence admits that the blanket A.S.M.I. specification is unsatisfactory, it seems to me that he has made the best argument that could be made for an alternate or classified specification, such as Mr. Forrest has proposed. The reason for differentiating along the lines of native and oil asphalt is obvious, as everyone knows they are the two main groups or classes of asphalt used in paving. If there was another important group there would be good reasons for making three classifications instead of two. There would be no reason for classifying brands of asphalt; there is every reason for classifying different kinds.

Yours very truly,
D. T. Pierce, Executive Assistant,
The Barber Asphalt Paving Company,
Philadelphia, Pa.

The International Joint Commission have issued a supplementary argument, under date May 15-17, 1917, in the matter of the "Measurement and Apportionment of the Waters of the St. Mary and Milk Rivers and Their Tributaries" in the United States and Canada.

Refuse Reduction Processes

Four Systems of Garbage Reduction Outlined—Sanitation and Convenience to be Considered—Paper Before A. S. M. E.

By Henry A. Allen, Chicago

THE main factors to be considered in the disposal of municipal wastes are sanitation and discommodity—the first as affecting the health of the individual and of the general public, the second as affecting the individual or public in the matters of inconvenience, unsightliness, and offensiveness.

Factors to Be Considered

In designing for a municipality, it is my opinion that the work should proceed along the following general divisions stated in the order of their importance:

Service.—Service requires that the apparatus and structures shall at all times be able to perform the duties imposed. In the case of waste disposal it means at all times required ability to collect, transport, and dispose of in a convenient and sanitary manner all wastes produced.

Discommodity. — Discommodity or inconvenience relates to handling in a manner least disagreeable to, and entailing minimum effort on the part of, the individual or public.

Attractiveness.—Attractiveness in structures is desirable, as its tendency is to make less acute any actual or imaginary odium attached to a plant, whereas neglect tends to magnify such.

Economy of Operation.—Economy of operation refers to the accomplishment of the work required in a most direct and inexpensive manner, having in view the obtaining of the greatest nett monetary returns compatible with good sanitary and inoffensive operation.

Cost.—This factor is put last because it is assumed that any legislative body, appreciating the necessity of a function, will provide funds for the actuation of that function.

Often conveniences are demanded by individuals or the public, in utter disregard of the fact that such cannot be had without commensurate expenditure of funds.

Economy in public works does not mean the apparent saving in moneys by the non-execution of a desired or required public improvement (so to speak, municipal deferred maintenance), but making each dollar appropriated go farthest in the execution of a necessary or desired public improvement.

Obviously it is to the engineering professions that the public must turn if it is desired to have solved in a logical and practical manner the various intricate problems of municipal waste disposal.

Selection of a Garbage-Collection Unit

Having been selected chief of the technical staff, created on the recommendation of the city's Waste Commission, the necessary engineering and working forces, including waste investigators, were organized and systematic studies began. At the same time work on the design and construction of a municipal reduction plant and collecting and handling equipment was being carried on. To facilitate this work it seemed to me that somewhere along the line from the production of waste to the point of final disposal a unit should be selected. The most difficult phase of the entire problem is getting the garbage from the kitchen to the collecting unit.

It was for this reason that the garbage box was selected. The larger the capacity of this unit, other things being equal, the less the cost of collecting and handling. Study showed that a six-cubic-yard box, when filled, became too heavy for a two-horse team, except on the very best of paved streets. As but 13 per cent of our alleys are paved and 62 per cent. of our streets, this prohibited such a unit being used throughout the city. So, taking all in consideration, the unit adopted appears to be the most satisfactory. This consists of a box 12 ft. long, 4 ft. wide, and 32 in. high.

Two such boxes can be loaded abreast, three in length and two vertically, making twelve boxes per specially designed railway car. One-half this number can be loaded on a specially-designed street car. The net loads of garbage contained will be approximately 34 and 17 tons respectively.

By adopting a standard collecting unit, hoisting equipment, including cranes, runways, and slings; hauling equipment, including wagons and tractors; transporting equipment, including railway and electric cars, steam and tow barges, become standards for loading and disposal stations for various wastes.

The studies so far conducted indicate that it may be considered an axiom that that system handling an offensive substance which exposes the least or fewest surfaces to contact with such substance is the most sanitary, least offensive, and, in general, commercially the best.

Systems of Garbage Reduction

Briefly, the following may be considered the present methods or systems of garbage reduction: Cooking process (Arnold and Edgerton), Cobwell system, chemical process, and drying process (Mertz and Simons).

In the cooking process the raw garbage is fed into large tanks called digesters, holding several tons of garbage each. These tanks are then closed and the contents subjected for several hours directly to a steam pressure varying between 40 pounds and 80 pounds per square inch, the tendency being to break down the cellular structures by boiling.

When the digestion is completed the emulsion of grease and tank liquors is drawn off. The solid matter generally is fed to a press where the main portion of the entrained oil and liquors is forced out, leaving a tankage containing 40 to 50 per cent. of moisture. The tank liquors and grease obtained from the cooking and pressing process are passed through a series of settling tanks or basins, in which the grease is separated gravimetrically and drawn off or skimmed from the top.

The tank liquors, which contain considerable fertilizer value, are treated in a multiple-effect evaporator to thicken before mixing with the degreased tankage.

The tankage, after pressing, is properly dried and subjected in a percolator to the action of a grease solvent, which absorbs the remaining grease. The saturated solvent is distilled off and condensed, leaving the grease, the solvent being ready to use again. The degreased tankage and liquor, called "stick-water," are mixed, dried, milled, and shipped. There are several successful reduction plants employing this process.

In the Cobwell system the green garbage is fed into a tub-shaped digester tank of several tons capacity, provided with a steam jacket or interior heating coils, and subjected to the direct action of a grease solvent at a temperature under 200 degrees Fahr. Dehydration takes place for several hours, during which time the vapors are drawn off and condensed. These vapors consist principally of moisture and a portion of entrained solvent. After condensation the solvent is separated from the water, and is ready for use again, the water generally being wasted.

During this operation a large proportion of the grease is dissolved in the solvent and the cellular structures for the most part broken down. The saturated solvent is drawn off.

Obtaining Grease

The tankage remaining in the digester is subjected to one or more washings of grease solvent, for the purpose of obtaining the greatest permissible amount of grease. The solvent, with the dissolved grease, is then drawn off and live steam introduced, as in the case of most percolator processes, to drive off as much of the remaining solvent as possible, to minimize loss. The tankage is then subjected to drying under vacuum by heat supplied from the steam jacket or coils. When the moisture content has been reduced to less than 10 per cent. the contained tankage is removed, ground, screened, and shipped.

It will be noted in this process that a large portion of the reduction is done in the one tank or digester.

Some of the latest municipal installations employ this system, among which are those in New Bedford and Los Angeles. The city of New York is endeavoring to build a plant, equipped with this process, of 2,000 tons capacity of green garbage per twenty-four hours, estimated to cost approximately two and a half million dollars. New York is having the common difficulty of securing a suitable location for the plant, owing to the objection of property-owners near sites deemed suitable.

The chemical process proposed by Dr. Hirsch has not been demonstrated with the required exactitude to enable competent engineering judgment to be passed upon it. It consists of a treatment tank containing several tons of green garbage, the garbage being subjected to the action of certain chemicals which convert the cellulose into dextrin, or dextrose, depending upon the temperature employed and the time. Personally, I have great hope that such a system may be evolved.

Dr. Morgan claims to have a process by which he produces alcohol directly from garbage. The experiments so far made by him have not yet, I am informed, been sufficiently conclusive to enable an engineering report to be made.

In the three systems above described it will be noted that the green garbage is fed into tanks, which are then closed and the contents exposed to treatment.

Chicago Reduction Process

The fourth process mentioned is the dryer process, and is the system in use at the municipal reduction plant in Chicago. In this process the garbage is generally first run through a crusher, to smash open cans of condemned foodstuffs and to break up other large material to permit of more efficient drying. The material from the crusher is then fed into dryers, its moisture content being reduced to 10 per cent. or less. From the dryers it is fed into percolators, where it is subjected to the action of a grease solvent. The grease-saturated solvent is then drawn off and the solvent distilled off and condensed for repeated use, the grease being treated and stored ready for shipment. Steam is then turned on to drive off any residual solvent, after which the tankage, which contains about 26 per cent. moisture, is withdrawn and then put through final dryers and dried to about 6 to 8 per cent. moisture. It is then screened, milled, and screened, and stored ready for shipment.

This system was one of the first employed, but in most cases has been replaced by the cooking process or its latest modification—the Cobwell system. My investigation convinced me that one great cause of offence at the plant of the Chicago Reduction Company was the use of direct-heat dryers and the consequent burning or carbonizing of certain greases and materials such as hair and flesh. This scorching action not only was the cause of offence, but also, I believe, the cause of loss in the amount and value of the by-products. The result was the installation of the more costly direct-indirect-heat dryers.

As predicted, when using the indirect-heat dryers not only has the necessity for scrubbing practically been eliminated, but the tankage and grease produced are better, with consequent increased values. The garbage is dried from 75 per cent. moisture to 10 per cent. or less in one cylinder.

The principal aim in designing this plant was to eliminate offence; therefore, not being content with the results thus attained, I thought it advisable to provide each dryer with a petticoat stack. This stack permits commingling of outside air with the gases escaping from the dryer, therefore cooling and throwing down a certain amount of moisture (which carries with it considerable very fine suspended matter), and, in addition, causing dilution.

The stacks are provided with suitable sprays for use in case of any possible emergency due to delayed collection in hot weather or accidental fire or overloading. It will be noted that each dryer is arranged in the newly-designed dryer building as a practically complete unit, having its own cyclone and petticoat stack.

Water Purification by Ultra Violet Ray Sterilization

THE town of Henderson, Kentucky, has for some months been using the ultra-violet ray method of treating its water supply. This is the first municipal installation in the world of the pressure type. The city obtains its supply from the Ohio River, and until 1916 used it with no treatment except such sedimentation as occurred in the distributing reservoir, which holds about one-and-a-half days' consumption. Then it contracted with the Pittsburg Filter Manufacturing Company and the R. U. V. Company for a sedimentation, filtration, and sterilizing plant with a capacity of three million gallons a day, with provision for doubling that capacity later.

The plant consists of two coagulating basins, each 95.5 by 30 ft. and 16 ft. deep; two baffled mixing chambers 25 by 17.5 ft. and 17.5 ft. deep; six filter units, each 17 ft. by 13 ft. 4 in., with a normal capacity of 625,000 gallons; and a sterilizer consisting of three legs, each comprising five units. The detention period in the coagulating basins is four hours, with a consumption of 3,750,000 gallons a day, and the capacity of the settling basins is 620,000 gallons. The basins and filters are of standard reinforced concrete construction, and are covered by a brick building. A clear water well underlies the filters and pipe gallery, and adjacent to this is an underground room 28 ft. by 17 ft., which contains the sterilizing apparatus.

The three legs of the sterilizer are connected in parallel and receive water from the clear water basin and deliver it to the suction well of the pumping plant. Each of the five units in each leg has a lamp box inserted in its side, equipped with a clear quartz V-shaped tube that projects into the body of the unit and around which the water is forced to flow in a thin film by means of the baffle placed at right angles to the long axis of the sterilizer. The quartz tube contains a 220-volt D.C. ultra-violet ray lamp consisting of a mercury vapor arc. A stirring device of the screw or propeller type operates in each unit to ensure that each particle of water passes within the range of influence of the lamp. On the main switchboard is a tell-tale incandescent so connected with each ultra-violet lamp as to indicate if any lamp fails or diminishes in power, a warning bell ringing to attract attention.

The plant was put into operation near the end of 1916, the amount of water treated daily varying from 2,200,000 gallons to 3,200,000 gallons. The R. U. V. Company guaranteed to produce water free from B. coli, with a current consumption not to exceed 0.77 kw. per lamp. These guarantees were reported to have been met during the test run. The consumption was 92.5 kw.-h. per 1,000,000 gallons.

The following figures are taken from daily tests run continuously for over two months:

Result of Bacterial Analyses During Test Run

Sample.	Total No. of samples.	Total bacteria per 1 cc., 24 hrs. incubation. Maximum count.	Average count.	Total B coli per 1 cc., 48 hrs. incubation. Maximum count.	Average count.
Raw	25	190,000	85,000	1000.0	276.0
Coagulated	25	1,200	720	100.0	45.0
Filter	70	320	80	1.0	.35
Influent leg No. 1	52	95	32	1.0	.260
Burner No. 1 . .	48	30	16	.8	.215
" No. 2 . .	48	20	8	.8	.200
" No. 3 . .	48	16	6	.2	.136
" No. 4 . .	48	6	2.1	.1	.09
" No. 5 . .	54	3	.31	0.0	0.0
Influent leg No. 2	53	75	36	1.0	.310
Burner No. 1 . .	47	50	12	.6	.273
" No. 2 . .	47	20	6	.8	.18
" No. 3 . .	47	7	5.2	.4	.117
" No. 4 . .	47	6	1.8	.1	.07
" No. 5 . .	54	3	.38	0.0	0.0
Influent leg No. 3	54	95	25	1.0	.326
Burner No. 1 . .	47	55	14	.8	.249
" No. 2 . .	47	19	9	.8	.21
" No. 3 . .	47	12	4	.1	.110
" No. 4 . .	47	6	1.6	.1	.06
" No. 5 . .	54	3	.12	0.0	0.0
Tap at pump . .	34	11	.39	0.0	0.0

Rates of pumping 2,200,000 gallons per day to 3,200,000 gallons per day, with little or no variation in results.

Turbidity of raw water varied from 130 to 880 ppm.

Filtered water usually clear with maximum turbidity of 5 ppm.

Ottawa Branch, C. S. C. E.

The Ottawa branch of the Canadian Society of Civil Engineers was addressed at their meeting on December 13 by Mr. F. Elcock, works superintendent of the Ottawa Gas Company, on the subject, "Coal Gas." His paper dealt with the manufacture of coal gas, explaining design and operation of the generating plant and the apparatus employed for the removal of by-products and impurities. A description of the manufacture of other gases supplied for domestic and industrial purposes and a description of the working up of the by-products was also included.

Stone in Engineering Work

THE builders of Imperial Rome expended a great deal of care and artistic effort on their engineering work, with the result that there have survived even to this day aqueducts, bridges, and the like, of decided architectural pretensions. These are to be found in what were then remote colonies of Rome, in Africa, France, and Spain. The mediaeval builders showed a like spirit, although they generally worked on a smaller scale. In modern times, however, the prevailing idea seemed to be that there was no need to make any attempt to beautify what was intended only for a work of utility. Strength and durability were the only factors worthy of consideration. Ornamentation was a useless expense, and, indeed, it was felt to detract somewhat from the utilitarian purpose. The skill and inspiration of the architect were not called upon to supplement the engineering design, which was based solely upon computations of stress and strain. There is nothing that better illustrates the growth of popular taste and aesthetic appreciation than the greater care that is now bestowed upon the designing of our public works. We are no longer content with rude masonry and bare walls, and we even call in the aid of landscape gardening to bring tremendous engineering products into harmony with their surroundings.

How far this spirit has spread anyone can understand who will recall the many industrial plants erected during the past few years. We have grown to make a fetish of efficiency, and those who study the subject declare that the money expended in making a manufacturing plant as attractive as possible both within and without is a paying investment, because it promotes a better spirit among the workmen. What in a former generation would be giving factories in squalid surroundings now look like public buildings in a public park. A most attractive little booklet, beautifully illustrated, has just been put forth showing what has been done in one Connecticut town in the way of providing housing for the workmen in a single mill. This is at Danielson. The mill-owners have organized a construction company, entirely independent of the mill, and taking in townspeople interested in the development of the place. The houses are attractive in design, and are fitted up in the most modern style, with all conveniences. The mill rents the houses from the construction company and sublets them, without profit, to its employees.

The introduction of concrete construction, where the plastic mass was poured into wooden moulds, did not aid in bringing about an architectural improvement in engineering work, but, on the contrary, hindered the movement in many ways. Stone masonry, however rude and unadorned, had a certain dignity that could never be found in a wall of poured concrete. The railroads are still great offenders in the use of this material, but leading engineers are demonstrating that stone facing is the proper treatment for heavy concrete construction. Many of the great dams erected in the United States irrigation and reclamation schemes are faced with stone, and are, in reality, beautiful and artistic creations that satisfy the most exacting taste. The Roosevelt dam in Southwestern Wyoming is an instance in point. This is a rubble masonry arch, with faces of ashlar. It rises 280 feet from bed-rock to parapet walls. It is 235 feet long on the bottom and 1,080 feet long on top.

It is probable that greater care was given to the architectural features, including landscape gardening, of the Catskill water supply system than to those of any other great engineering work ever undertaken. The recent completion and dedication of this project has served to emphasize this fact. The Kensico dam would be notable for its size alone, as it contains not less than 1,000,000 cubic yards of masonry, while the famous Assuan dam, on the Nile, has only 704,000 cubic yards. But its prominent location, at the end of the Bronx Parkway from New York, inspired the commission to make it more than a mere retaining wall.

This dam, facing south, presents a curved surface as high above ground as a ten-storey building and nearly as long as from Thirty-fourth Street to Forty-second Street, says the New York Post. Moreover it has the novel characteristic (never before considered in the architectural design of such a structure) of being built in sections, expansion joints cutting the face of the whole mass vertically in widths of about eighty feet.

In studying existing dams the architects found little precedent to aid them. Some were crowned by a sort of house cornice; one, in France, had an interesting surface texture given it by the projection of "headers," square stones forming a pattern in the wall. None had anything like a visible base (their ends disappearing irregularly into the backfill of the flanking hills), and below the dam an arid flat, occasionally decorated by an octopus of roads centering on an inadequate fountain, offered a depressing contrast to the beauty of the reservoir above the dam. Moreover, these great walls, composed often of huge stones, had no "scale," gave no just impression of their size, because their surfaces were of uniform texture and lacked contrast.

The requirements gradually formulated themselves in the architects' minds:

1. A dam should stand upon an architectural base.
2. It should not have a "cornice."
3. Its surface should be divided into the panels indicated by the vertical expansion joints.
4. Its surface should be divided into the panels indicated by the vertical expansion joints.
4. Its surface should follow a single curve, and not a series of varying curves with uncertain angles between them.
5. Small structures or shelters, with parapets or balustrades indicating the height of the human figure, should give "scale," or measure, to the dam.
6. A large area of water, pools or fountains, should mitigate the foreground of the dam; and
7. The approach from which the dam is first seen should be as long as the conditions allow.

Ten years ago the architects prepared the first sketches for the general design, indicating the wall textures, base-terrace, shelters, foreground, and approaches. Repeated plaster models at small scale gave valuable help, but it was not until a full-size model of granite, with a face some thirty feet square, was built on the east hill at the site, and could be studied from half a mile away, that it was possible to cut the first stone for the dam itself.

Granite of extraordinary beauty and variety was found within a mile, and two million cubic yards were quarried, a large portion being used in the cyclopean masonry and concrete which constitute the mass of the dam. In the cutting-sheds of this quarry the frieze of shields and garlands was "carved" with ordinary rock drills and surfacing machines, presenting, close to, an aspect of savage brutality which at half a mile is refined to the character of the general wall surface.

Across the foot of the dam, parallel with the terrace forming its base, a pool was built, in which nine jets of water, one opposite each panel of the dam, spout their vertical columns forty feet into the air. Two narrow fountain-basins flank this pool, lying perpendicular to the dam face, and the overflow of these three basins flows into the Bronx River and down the Parkway, to compensate for the loss of the water from the Kensico watershed now caught by the dam.—Stone.

Change in Organization of Architectural and Engineering Firm

MR. Bernard H. Prack, industrial architect and engineer, whose business in the past has been known to the building community as Prack & Perrine, will hereafter be known in business as Bernard H. Prack, industrial architect and engineer, with offices as at present, at 801-4 Keystone Building, Pittsburgh, Pa., and 808 Lumsden Building, Toronto.

Mr. Prack, whose home for the past seven years has been in Hamilton, specializes in the building of foundries, machine shops, power plants, and also in equipment, and is making a specialty of producing complete industrial buildings.

A few of the Canadian buildings designed by Mr. Prack are as follows: office and factory buildings for the Canadian Westinghouse Co., Ltd., Hamilton; power plant for the Dominion Power and Transmission Co., Hamilton; Oliver Chilled Plow Works, Hamilton; Standard Underground Cable Co., Hamilton; Wm. Wrigley, Jr., factory, Toronto; Canada Cycle & Motor Car Co. plant, Weston, Ont.; Cowan Chocolate Co. plant, Toronto; B. J. Johnson Soap Co. factory, Toronto; and numerous other large plants throughout the Dominion.

Tension in Cableway Easily Found

THE proper size of track rope for a given cableway is that which will have a factor of safety of four when the maximum load to be handled produces a deflection at the center equal to one-twentieth the span, according to engineers of the manufacturers of Hercules wire rope. The deflection is measured below a straight line between the points where the track cable passes over the towers. One anchorage should be arranged with a set of falls, so that the track cable can be let out or taken up with seasonal temperature variations to maintain this deflection and tension.

An approximate rule, which gives close results for loads in the center with the deflection equal to one-twentieth of the span, gives the tension in the track rope as five times the load plus two and one-half times the weight of the suspended rope.

Contractor on Mount Pleasant Bridge

In the description of the Mount Pleasant Road cantilever arch bridge, which appeared in the last issue of the Contract Record, the name of the contractor was omitted. This work was done by Mr. C. J. Townsend, engineer and contractor, Toronto.

Important Conclusions from Recent Tests on 200 Steel Columns

CONSIDERING the enormous quantity of steel annually used as columns in bridges and buildings, it is remarkable that tests of column strength have been so few in number and on so small a scale. Experimental investigation of the strength of full size columns has been sorely needed, and at last a series of tests on 200 built-up columns has been completed in the Washington Laboratory of the Bureau of Standards under the direction of George R. Olshausen. Comments on these tests are made in Engineering & Contracting.

These tests disclose the remarkable fact that although the chemical composition and the tensile strength of the steel in two similar columns may be the same, one of the columns made from one lot of steel may show a third less strength than another column from a different lot. This indicates that the compressive yield-point of steel may vary considerably, even where there is no variation in tensile strength. Compression tests on channels and I-beams now in progress confirm this conclusion. The compressive yield-point is certainly affected by the process of rolling the steel, for columns made of steel ¼ inch thick showed about 10 per cent. more strength per square inch than those made of steel ½ inch thick. In general, the columns made of thick metal showed less unit strength than those of thin metal. Apparently the degree of compression by rolling affects the compressive yield-point to an extent hitherto not appreciated.

Another surprising result of the tests is the demonstration of the fact that tie-plated columns are much weaker than latticed columns. On the average the tie-plated columns were only 60 per cent. as strong as the latticed columns. The tie-plates were about 8 inches in height and 10 inches wide, and spaced about 4½ feet centre to centre. Had they been spaced less far apart, the resulting strength would probably have been greater. Nevertheless, these tests seem to indicate that latticed columns are to be preferred to tie-plated columns.

The tests on solid section, built-up columns show that the shape of the section has no influence on the column strength.

Effect of Slenderness Ratio

In the matter of the effect of the "slenderness ratio" or "length ratio" (i.e., length divided by radius of gyration), the tests serve to establish one important fact, which is in concordance with previous knowledge. A pin-ended column whose slenderness ratio is 25 or less, or a square-ended column whose slenderness ratio is 50 or less, has an ultimate unit strength only slightly less than the compressive yield point of the steel in short blocks. The steel used in these tests had a yield point of about 38,000 lbs. per square inch and a tensile strength of about 60,000 lbs. per square inch in small-sized pieces.

For slenderness ratios up to 72 for pin-ended columns, there was found to be a decrease in unit strength fairly in accordance with the theoretical formulas in common use; but the influence of the yield point is shown in all tests up to a slenderness ratio of 72 for pin-headed columns. Hence the Euler formula fails of complete generality.

All tests were made on square ended columns, hence the slenderness ratio of the square-ended columns must be divided by 2 to convert to the equivalent slenderness ratio of pin-connected columns. It is to be hoped that later tests will be made to establish experimentally the correctness of the theory upon which the use of this factor of 2 is based. It is also to be hoped that pin-ended columns of greater slenderness ratio than 72 will be tested.

The strain-stress curves of the column tests are straight lines almost up to a unit stress equal to the compressive yield point of the metal in short blocks. Then there is sudden flattening of the strain-stress curve. Hence the factor of safety is practically equal to the compressive yield point divided by the working stress, for equivalent pin-ended columns having a slenderness ratio of 25 or less. The average ultimate strength of such short columns ($l \div r = 25$) was about 33,000 lbs. per square inch, but there were variations, both ways, of 20 per cent. from this average. For equivalent pin-ended columns having a slenderness ratio of 60 the average ultimate strength was 26,000 lbs. per square inch, and here again variations of 20 per cent. from the average occurred. As previously stated, columns built of thin metal showed considerably greater unit strength than those of thick metal. So uniformly was this the case that it would seem that ultimately it may become the practice of designers to use higher working stresses for thin sections. These results show very clearly the futility of great requirements in calculating unit stresses in columns. What avails it to know the stress almost exactly, when such wide variations in ultimate strength exist?

Montreal Bureau of Research Claims Street Maintenance Allowance is Inadequate

In a preliminary report, the Bureau of Research, now conducting an enquiry into the affairs of Montreal, suggest that the provision contemplated for 1918 of $305,000, distributed in the proportion of $240,000 for the resurfacing of pavements and $65,000 for repairs, is entirely inadequate, and will be practically wasted if an attempt is made to distribute the amount over the entire city. It is recommended that the chief engineer should submit a definite program for the resurfacing of the streets, dealing first with those streets presenting the greatest need by reason of traffic demands and postponing the less important streets to a later date. A permanent street maintenance force should be established. Aside from the periodic resurfacing of pavement that is necessary, all paved streets, from the time the original construction is completed, should be maintained.

Supply Concern Changes Name

The Consolidated Boarding and Supply, 1838 Transportation Building, Chicago, whose head office for Canada is located at Montreal, and branches at Sudbury, Toronto, and Schreiber, has changed its name to the Mosher & Crawley Company. There is no change in the financial end of the business. George H. Mosher and M. D. Crawley, the partners in this firm, are both known to many railway men, as they have been associated together in this work for the past twenty years.

The Canadian Good Roads Association, at a meeting in Montreal, decided to hold the next Good Roads Congress at the Armory, Hamilton, commencing on Tuesday, February 26, and closing Saturday, March 2.

THE ONE CHOICE

By Edgar A. Guest

Taking the bad with the good, taking the good with the bad,
Clinging to faith in our sorrow, living the days that are glad,
Blindly we follow the pathways mapped out for all mortals to tread—
This is the battle called living, and nobody knows what's ahead.

The goal of our strife isn't told us, we know not what waits at the end,
Nor the length of the journey we're making nor how many years we shall spend;
As soldiers who go into battle aren't told of its purpose or plan,
So we come to this world under orders to take up the labors of man.

We are here, and it's not of our choosing, nor the ultimate goal may we choose,
We shall learn from the Master who sent us the final result of life's cruise;
But we have one choice that's unhampered, servants we are and yet free—
We may choose from life's good and its evil, we may say what the soul is to be.

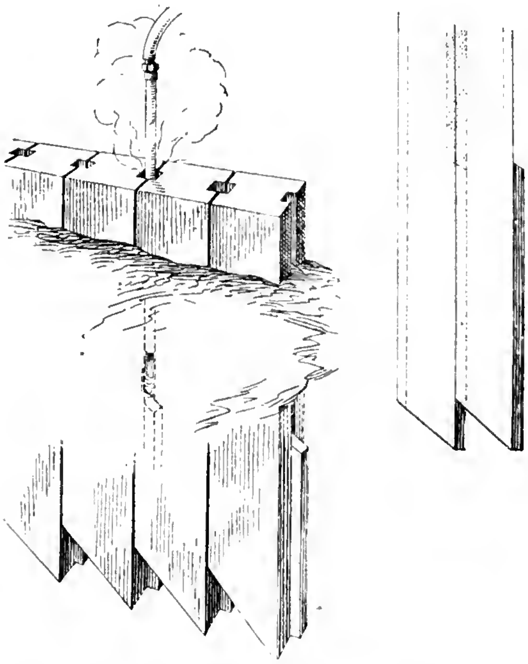
It isn't for us to determine how long we shall live, but how well;
The purpose of life and its struggle is something no mortal can tell;
We can choose not our coming or passing; that summons the Master must give,
But each, to his fancy or thinking, may pick out the way he shall live.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Steam Jet Cleans Debris from Grooves of Concrete Sheet Piling

STEAM under 200 lbs. pressure was found to be the very best way of cleaning out the debris from the slot formed by the opposing grooves in adjacent concrete sheet piles which were designed to be filled with grout to make the job tight. The construction of these piles can be seen in the accompanying illustration from Engineering News-Record, which shows also the 5-foot guiding tongue at the bottom and the wedge-shaped point of the pile, which was to keep the following pile snug up against the one driven just before. The tongue, of course, followed in the groove of the preceding pile, and was expected to clean out this groove.



Steam at high pressure clears slots in sheet piling.

In spite of the care taken to prevent the entrance of debris, many of the slots were completely choked before the grouting could be attended to. The removal of this debris presented a problem of many difficulties, and though several methods were tried, no one of them proved of any value until the contractor hit upon the idea of using a steam jet for this purpose. By using steam from a locomotive which could be spared occasionally from work in another part of the job, steam was delivered at 200 lbs. pressure through a three-quarter-inch pipe which was so rigged that it could be raised and lowered in the groove. A considerable quantity of water was used with the steam when the cleaning was started, and this helped to loosen the material, which was then expelled by the dry steam. The work was done by Teichert & Ambrose, contractors, Sacramento, Cal., and was part of a continuous curtain wall of concrete sheet piling, 2,085 feet long, built for a bypass weir, near Sacramento.

Frames of Pipe Covered with Canvas Protect Newly Laid Concrete

In building a 60-foot concrete road in Pennsylvania during the past summer a new method of protecting the newly-laid concrete was used. Frames covered with canvas were moved along as work progressed. The frames were 10 feet wide, making it necessary to have twenty on hand to cover one day's run. The first frames built were of 1 x 4 inch pine boards, covered with a coarse grade of muslin. These answered the purpose very well, but it was found that they broke too easily, so later the frames were made of 3/4-inch pipe, covered with canvas. This form of covering gave protection from the sun, without marring the surface, and effectively shed the heaviest rains.

Movable canvas covered frame protects concrete.

Special Device Recovers Pump from 225 ft. Well After Unsuccessful Attempts

WELL No. 9, at Mason City, starts with a 19-in. hole, which continues for 225 ft. At that point the diameter is reduced to 16 in., and at 540 ft. it is again reduced to 12 in. The well is 1,200 ft. deep. In this well is installed a five-stage 17-in. American deep-well turbine, motor driven. The turbine proper is at about 90 ft. below the well curb, and below the turbine are two lengths of 9-in. suction pipe. Water normally stands in the well at about 85 ft. below the curb and pumps down about 7 ft. when yielding 1,200 gallons per minute.

The construction of this type of pump and its connections are well known. The weight of the pump is carried by the 10-in. flanged discharge pipe in 8-ft. lengths. Inside this discharge pipe is another pipe 4 in. outside diameter, held in position by spiders inserted in the flanges of the discharge pipe. This pipe is connected together by means of screw couplings, which also serve to hold the shaft bearings. Inside this pipe is the shaft.

We make a practice of overhauling this pump once a year, and were doing so on New Year's day of this year, said Mr. W. A. Judd in addressing the Iowa section of the American Waterworks Association. The pump had been lowered, together with four lengths of discharge pipe shaft casing and shafting. The fifth length of shafting had been screwed up tight, and the fifth shaft casing was being set up solid when, without any warning, casing and shaft disappeared through the discharge pipe, and with the pump and two lengths of discharge pipe went bubbling down to find a resting-place on the ledge at 225 feet below the surface. The two remaining lengths of discharge pipe were pulled out, and it was found that in making up the shaft casing joint the discharge pipe had come loose from the flange.

Unsuccessful Attempt to Couple to Shafting

A well driller's advice was immediately sought, and he advised us to try to couple on to the shafting, which projects about a foot above the bearings. One of the shaft couplings was taken to a machine shop and the threads recut to make a loose fit. One end was tapered out on the inside and the other end was cut down to a 2-in. pipe coupling. On the bottom was soldered a heavy funnel to centre the coupling over the shaft. Two-inch pipe was then cut into about 10-ft. lengths for ease in handling and threaded. Because the shafting has a left-hand thread, it was necessary to drill each pipe coupling after the joint was made up and pin the pipe and coupling together. This was a tedious process, but finally the funnel was heard to strike the shaft. It was then raised and lowered a few times, to be sure of centering, and we started to twisting the pipe to the left. After several attempts it seemed to take hold and hoisting was attempted with an 8-ton chain hoist, which hangs from a trolley running on a 15-in. I-beam near the roof of the pumphouse. From the hard pull, we knew we had caught hold of the shaft, but at about the third pull on the chain the coupling let loose, and for a day we fished continuously without getting another nibble. The string of pipe was then pulled out, and it was found that the funnel had bent over, allowing the shaft to centre in the funnel, but to one side of the coupling. A heavier funnel was built, reinforced with steel ribs and bands, but, even with this, we had no luck, the shaft turning every time the threads engaged.

Special Tool Does the Work

During this time our day fireman had been telling of a fishing tool he had heard of, consisting of two rings. Just how the rings were operated no one knew until our blacksmith, who is a Britisher, said, "I gather you," and started to make the tool.

The small end of the funnel was cut off so the hole was cut off so the hole through it was about 5 in. in diameter. A fork was made, to which the funnel was riveted. Above the fork was welded a piece of 2-in. shafting 3 ft. long, in such a way that when the shaft and funnel stood vertical the face of the steel was about 2½ in. from the vertical line drawn through the centre of the funnel. On the back side of this bar two ears were welded and punched for a 1-in. bolt. Two open rings were made, 5 in. in diameter, of ¾-in. square steel, with the ends bent back, flattened out and punched also for a 1-in. bolt. The top of the bar had a piece of 2-in. pipe welded to it; the rings were bolted to their places and wired together so they would move together on the bolts, and a light wire was fastened to the top ring to hold them in horizontal position. The funnel centered the tool over the shaft-casing all right, but when the rings were dropped by slacking the wire they did not bite into the casing enough to stand a pull, so the tool was again pulled out, a tool steel face put on the rings, and then notched. A piece of flat tool steel was welded to the face of the vertical bar, and in it were cut some teeth, making it look like a wood rasp. The tool was again lowered, and at 10.30 on the morning of January 7 caught hold of the shaft casing with a grip that scarcely anything could disengage. At the first pull it was evident that the pump was wedged tightly into the well, for instead of the pump rising, the I-beam above was bending. Men were sent for props to put under the beam, but while they were gone the tension on the hoist suddenly slackened, showing that the pump was loose in the well, and pulling was started. At 10 o'clock that night, after pulling continuously, without stopping even to eat, the pump was landed on blocking on the well curb.

Trade Publication

Waste and Wipers—Folder distributed by Scythes & Co., Ltd., Toronto and Winnipeg, describing their product, the "Dominion waste and wipers."

Mainly Constructional

East and West—From Coast to Coast

The total value of the building permits issued at Sydney, N.S., for the month of November was $46,585.

The building permits issued in St. Catharines, Ont., for the month of November reached a total value of $56,410.

The Port Arthur building permits for November, 1917, amount to $5,932, an increase of $1,478 over the same month last year.

The city council of Galt, Ont., have passed a by-law providing for an expenditure of $18,558 for extensions to the waterworks system.

The municipal council of Surrey, B.C., at a recent meeting passed by-laws to establish a road from White Rock to Ocean Park and a road through to the Timberland Company's new mill.

The offices and warehouse of the Dunlop Tire and Rubber Goods Company at Halifax are reported to have been completely destroyed by the recent explosion. The entire staff, however, are safe.

According to a report by Chairman Lane of the Road and Bridges Committee of the council of Lincoln county, Ont., the twenty-five bridges throughout the county are, on the whole, in good condition.

A survey was recently made by S. Stewart, district government engineer, of a proposed road southwest from Red Deer, Alta., through West Park, and various plans for its layout have been submitted to the council by the city commissioners.

At a recent conference between the chairman of the Toronto-Hamilton Highway Commission and representatives of Wentworth County, East Flamboro and Nelson townships, it was agreed that the spur line, from the highway in

Flamboro, be built as a county road. The government will pay 40 per cent. of the cost and the balance will be paid by the county and townships interested.

A second track is being built for a part of the way from the Grand Trunk main line station at Whitby, Ont., to the military hospital on the lake front of the town. It is to provide passenger service for the patients travelling the mile and a half between the hospital and the station.

The town of Brockville is soon to be linked up with the Ontario Hydro-electric system through the transmission of ten thousand horse-power from the Cedars Rapids Transmission Company. The work of erecting poles and wires from Morrisburg to a point near Cornwall will be proceeded with immediately.

The Komnick System Sandstone Brick Machinery Co., Ltd., has been licensed as an extra-provincial company in British Columbia and is authorized to carry on business in that province. The head office of the company is in Toronto, Ont., and its provincial headquarters in British Columbia are in Vancouver.

The bridge which is being built for the G. N. Ry. at New Westminster, B.C., to carry the North road over their tracks, is nearing completion. The concrete piers and abutments were reported to have been finished some time ago and the work of placing the girders has commenced. A. Guthrie & Company are the contractors.

In November, the city architect of Montreal issued 85 permits at a value of $219,355. This compares with 131 permits at a value of $865,530 in the same month last year. The total for the eleven months of the year is 1,554 permits at a value of $4,299,053, as compared with 1,800 permits valued at $5,005,464 for the corresponding period in 1916.

Col. Robert Low, head of the reconstruction committee, requests that all workmen, foremen, superintendents, timekeepers and other help who have been with him in the construction of different camps in Canada report at once to Bate McMahon's office, 21 Central Chambers, Elgin Street, Ottawa, if they are prepared to come to Halifax on reconstruction work in connection with the rebuilding of the devastated area there.

The Board of Road Directors of Middlesex County, Ont., have adopted the recommendation of county engineer Talbot as to which roads shall be recommended to the Minister of Public Works as provincial roads. These are as follows: The Sarnia Gravel Road, from London to Sarnia; Longwood and Talbot Roads, to St. Thomas and Detroit; Proof Line Road, to Goderich; Whiton and Governor's Roads, through Thorndale to Stratford; the Hamilton Road, to Ingersoll.

Work will be continued all winter on the additions to the Point du Bois power plant at Winnipeg, according to Mr. J. G. Glassco, manager of the city light and power plant. The most difficult portion of the work has been accomplished. This was the excavation of the rock close to the already existing plant, which had to be carried out with the greatest possible care in order to avoid damage. A gang of 75 men is being maintained and it is expected that the work will be completed next summer. The pouring of the concrete for the foundations was recently started.

The recent fire at the Polson Iron Works plant, Toronto, destroyed the pattern storage warehouse, the carpenter shop, the pattern shop and the mill, as well as a couple of other storage buildings. The greatest damage, however, was to the steel hull of a 3,500 ton standardized freighter. This vessel was being built for a Norwegian firm and was one of 18 of this type to be constructed by the Polson Iron Works. It was almost completed, but the fire warped the hull so badly that it will be necessary to replace fifty plates. This will cause a delay of about four weeks.

The following is a list of buildings costing $50,000 or more, which were destroyed or very badly damaged in the recent explosion at Halifax:—Canadian Government Railway round-house, Canadian Government Railway station, Halifax brewery, dry-dock and Government warehouse, Hollis and Sons' foundry, King Edward Hotel, Armories, Market Hall, military hospital on pier, Wellington barracks, Arcadia sugar refinery, Dominion Textile Company's factory, Halifax Exhibition buildings, Alexander McKay school, Brunswick Street Methodist School, Canadian Government repair shops, Richmond, St. Mark's Anglican Church, St. Joseph school, Home of the Deaf, Protestant Orphanage, Admiralty House.

The question of water supply has of late been receiving consideration in the town of Amherstburg, Ont. A proposition has been recently brought forward by the Brunner Mond Company, who are establishing a large plant at that point, that the town take their water supply from a new waterworks plant which the company intend to erect for their own use. The water supplied to the municipality would be filtered and purified, and 300,000 gallons would be the minimum amount to be taken daily. The townspeople appear favorable to the proposition, as the present water supply is not pure, and it would cost them more to make the necessary alterations and additions to the present plant than it would to buy from the company.

The following, prepared by the reconstruction section of the Halifax Relief Committee, is an estimate of material required for the temporary repairs to be done in Halifax so as to make damaged houses available: Glass, 1,000,000 lights, assorted sizes; putty, 50 tons; sashes, 18,000; doors, 2,000; scantlings, 250,000 B.M.; boards (matched), 1,000,000 ft. B.M.; roofing paper, 5,000 square feet; wall board, 300,000 square feet; nails, 1,000 kegs, 2½ to 4 in. The above does not include any material which may be required for dwellings which have been completely demolished, nor for public buildings, railway terminals, manufacturing, industrial buildings, or walls. It is requested that all who are desirous of forwarding material communicate with Col. Robt. S. Low, chairman of Reconstruction Committee, Halifax Hotel, Halifax, N.S., in order that overlapping may be avoided.

A report was recently submitted to the city council of St. John, N.B., by the commissioner of public works, in regard to the paving of track sections. The city has raised objections to bearing the whole expense of this work, but the New Brunswick Power Company contend that they should not be called upon to do or pay for any paving. Until the matter is definitely settled, the commissioner recommends that the city temporize with the street surfaces in the track sections and that it should not construct any foundation under the tracks, as he states that the cost of the foundations should be borne entirely by the company and the $5,000 per mile paid by them to the city is insufficient. As to the paving of the streets, the commissioner suggests that permanent pavement be laid on the sides of the streets only, stopping at 18 inches from the rail, and surfacing the remaining space outside the track with a thin layer of mixed asphalt and stone, graded and rolled. Between the rails only a temporary treatment with gravel and stone would be provided.

Personal

Col. Robt. S. Low, whose name is so well known in connection with the construction of Canada's military camps, has been appointed chairman of the Reconstruction and Repair Committee at Halifax, which is to have charge of the construction and repair work in the devastated city. Mr. Hamilton Lindsay has been appointed assistant manager.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Barrie, Ont.
The Town Council contemplate the construction of sewers on Mary St., between Sophia and Wellington Streets, and Holgate St., from the Western House to William St. Engineer, J. S. Laing.

Delta, B.C.
Town Council contemplate drainage system, costing $18,000. Clerk, N. A. McDiarmid.

Galt, Ont.
By-law will be submitted for an extension to waterworks system, costing $18,558. Engineer, W. H. Fairchild.

North Vancouver.
By-law to be submitted to appropriate $35,000 for water-main, etc., part of which will be expended to lay large water-main to the Robert Dollar Lumber Company, Riche Point. Clerk, J. F. Collins.

Oshawa, Ont.
The Town Council contemplate the construction of a sidewalk on Kitson Rd. Clerk, Thomas Morris.

Pictou, N.S.
Town Council contemplate the construction of sewers on Water, Front, and Church Streets, at a cost of $60,000. Clerk, Fred MacKaracher.

Quebec, Province of.
The Department of Public Works, Dominion Government, Ottawa, contemplate the construction of roads in the Abitibi and Matapedia Valley. Secretary, H. C. Desroebers.

Windsor, Ont.
Water Commission, City Council, contemplate installation of two electric pumps. Clerk, M. A. Dickenson.

CONTRACTS AWARDED

The Pas, Man.
The Northwest Lumber and Supply Company, Eighth and Ottawa Streets, Regina, have the general contract for sewer lift for the Town Council.

Vancouver, B.C.
Evans, Coleman & Evans, Ltd., Fort Columbia, have the contract for cement, steel, and brick for 35,000 sewer to be constructed in Tenth Ave. by the Vancouver and Districts Joint Sewerage and Drainage Board, City Hall.

Railroads, Bridges and Wharves

Portage la Prairie, Man.
By-law has been submitted for roads and bridges, costing $170,000. R. M. secretary-treasurer, D. McCowan.

Sifton, Man.
By-law has been submitted for highways and roadways, costing $59,800. Clerk, R. H. Hochin, Oak Lake.

Sault Ste. Marie, Ont.
The Canadian Pacific Railway, head office Montreal, contemplate the erection of an addition to their frfeight shed. General purchasing agent, E. N. Bender, Montreal.

Toronto, Ont.
The following contracts have been awarded in connection with the erection of the Union Station for the Toronto Terminal Railway Company, 36 King E.: Wiring, Canadian Comstock Company, Ltd., 10 Cathcart St., Montreal; ventilating duct work in connection with heating contract and roofing and galvanized iron work, McFarlane-Douglass Company, Ltd., 34a Dorchester St. W., Montreal; elevators, main and west wings, Otis-Fenson Elevator Company, Ltd., 50 Bay St.; elevators, east wing, Turnbull Elevator Manufacturing Company, 126 John St.; ornamental iron, exterior opening doors and elevator door fixtures, Architectural Bronze and Iron Works, Lansdowne Ave.; exterior ornamental iron and stairs, John Watson & Son, Ltd., 167 Wellington Street, Montreal; concrete retaining wall and approaches, Church, Ross Company, Ltd., 40 Hospital Street, Montreal; wood window frames, R. Laidlaw & Co., 65 Yonge St.; terra cotta fireproofing and floor arch partitions, Dominion Fireproofing Company, Ltd., 503 Confederation Life Building, Winnipeg; Guastavino masonry, R. Guastavino, Boston, Mass.; metal weather strip, Chamberlain Metal Weather Strip Agency, 598 Yonge St.; sewerage and drainage, Bennett & Wright Company, 72 Queen St. E.; glass, Consolidated Plate Glass Company of Canada, Ltd., 241 Spadina Ave.

Windsor, N.S.
The Dominion Atlantic Railway Company are building a freight shed. Superintendent of work, William Moses, Yarmouth.

Public Buildings, Churches and Schools

Clarkson, Ont.
The Lake Shore Country Club, head office Lumsden Bldg., Toronto, have secured site and will erect buildings.

Glace Bay, N.S.
The Department of Marine and Fisheries, Dominion Government, will reconstruct lighthouse which was recently destroyed. Chief engineer, W. P. Anderson.

Midland, Ont.
Town Council contemplate erection of a memorial hospital on Yonge St. Clerk, Frank R. Weston.

Montreal, Que.
The erection of a school on Forsythe Street is contemplated by the Roman Catholic School Commission, 87 St. Catherine St. Secretary-treasurer, N. Lafontaine.

The Roman Catholic School Commission, 87 St. Catherine W., contemplate alterations to schoo lat the corner of St. Hubert and Cherrier Streets. Secretary-treasurer, N. Lafontaine.

The Roman Catholic School Commission, 87 St. Catherine W., contemplate the erection of a school at St. Denis and St. Valiere Streets. Secretary-treasurer, N. Lafontaine.

Moose Jaw, Sask.
The Children's Aid Society have purchased a site, on which they will erect a $40,000 children's home. President, Arthur Hitchcock.

Nelson, B.C.
The Military Hospitals Commission, 22 Vittoria St., Ottawa, will erect three pavilions at the Balfour Military Sanitorium. Officer in charge, Capt. W. L. Symons.

The Kootenay General Hospital have made application to the Council for installation of electric light and gas service, costing $1,180.

Ste. Anne de la Pocatiere, Que.
The congregation will rebuild church recently destroyed by fire, at a cost of $200,000.

St. Henri de Mascouche, Que.
Plans and specifications with the architect, P. L. W. Dupre, 15 St. Lawrence Boulevard, Montreal, who will receive tenders until December 31 for the erection of a $15,000 boys' college for the school commissioners.

Toronto, Ont.
The Separate School Board contemplate the erection of a school on Kendal Ave., north of St. Clair. Secretary, J. G. Hall, 65 Bond St.

Vancouver, B.C.
The School Board contemplate the erection of ten school additions. Secretary, G. Upton.

Victoria, B.C.
Christ Church congregation contemplate extension, costing $3,000 to cathedral. Dean, C. S. Quainton, 852 Burdett Avenue.

Walkerville, Ont.
Plans and specifications with the architect, Brig. Miller, Albert St., Toronto, who will receive tenders until about December 26 for the erection of a $10,000 hall and residence for the Salvation Army.

CONTRACTS AWARDED

Amqui, Que.
Paquet & Godbout, St. Hyacinthe, have the general contract for $100,000 church for the Roman Catholic congregation.

Lachine, Que.
The following contracts have been

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Principal Contents

The New Parliament Has Seventy Lawyers and No Engineers

THERE is much food for thought in a recent press item detailing the composition of the newly-elected Dominion Parliament. That in this body there should be, so far as present knowledge indicates, seventy lawyers, eighteen physicians, and but **one contractor and no engineers**, leaves one rather skeptical as to the effect of the attempts to bring engineers into the political field. Within the last two years there has been an awakening in the engineering profession, a growing realization of its power and influence, and a tendency to concentrate efforts on making this influence felt. Men high in the profession have been urging their fellow-engineers to make use of their talents for the benefit of the community and the nation, feeling that familiarity with the various essentials of the national development opens the way for the engineer to right the wrongs, misconceptions, and fallacies of our governing bodies.

To enter body and soul into the greater national life requires the overcoming of two obstacles—the engineer's aversion to political life and the public's ignorance of the engineering mind. The surmounting of these must, unfortunately, be essayed from one angle only—it is the engineer who must master his own reluctance as well as the layman's lack of appreciation.

This double duty may make the problem, in a measure, complex, yet the evidences of glaring mistakes in our governmental methods have been making their constant appeal to the engineer. In the last three years this appeal has been greater than ever before, for the world struggle calls for that organization and systematization which only the engineering mind is able to provide. In spite of the essentially engineering nature of the war itself, and of the organizations for its prosecution, the lawyers have been monopolizing influential administrative positions and the engineers have been very largely relegated to the background.

In the recent election the profession had its chance to make its influence felt, not only for the general betterment of politics, but for the great cause that is making patriots of our engineers and for the great problems that are embracing this country's immediate attention. This was their opportunity, and yet, according to the report in hand, out of the two hundred odd members in the Dominion Parliament, there is **not a single engineer and but one contractor.** Wherein lies the cause is difficult to state, but at least it just serves to indicate that there must be no cessation to the efforts of carrying on the great work of bringing politics within the scope of the engineering profession. Pressure must be brought to bear on the members of the profession until there is a general realization of the benefits to be derived from more intense interest in national and political life. The record of seventy lawyers and no engineers only gives the lie to the statement that engineers have realized their duty—it is not a record to be proud of, nor is it one that cannot be easily improved.

Engineering Students Should Be Exempted From the Draft

UNDER an order dated December 8, the selective service regulations issued by the Secretary of War of the United States exempt certain engineering students from the draft, on the ground that their services are more valuable in the exercise of the profession for which they have specially fitted themselves, than they would be as privates in the ranks.

All engineering students are not to be exempted, but merely those who have shown special adaptability for the work, and the basis on which the selection will be made is as follows:—The faculty of each engineering school will go back through its records of the past ten years and endeavor to establish, on the basis of scholastic markings and subsequent professional performance a grading above which would be classed one-third of the graduates of the school. Having arranged that grading in any way satisfactory to themselves they will then consider the draft-age students in the school and recommend for exemption those who are apparently above this established grade. It will be seen that this mode of classification may include very many more than one-third, or, it may be, very many less than one-third of the students actually in attendance at any college.

The point to which we wish to draw special attention is that in the United States they have considered the engineering profession of sufficient importance to grant the students special exemption so that they may complete their courses. The sentiment of the War Department appears to have been voiced in a recent address by ex-President Taft before the annual meeting of the American Society of Mechanical Engineers. Mr. Taft said: "You engineers constitute one of the two professions that are indispensible to the country in the carrying on of the struggle in which the people of the United States are now about to devote themselves—yours and the medical profession. Congress and the Administration should see to it that the medical students and the engineering students should be reserved for the work for which they are particularly fitted; that the engineering students and the medical students should be required to go on and complete their preparation as engineers and physicians so that they may become engineers and doctors and may then be gathered into the service."

What is Canada doing in this respect? Special instructions have been given to exempt medical, dental and veterinary students. No exemption is being granted engineering students. Are engineers less valuable in this war than dentists? Are they occupying a place secondary in importance to veterinary students? If so, why is it called an engineers' war? We have repeatedly voiced the opinion that engineers are almost equally essential with medical men in this war. Is it not time our engineering societies should make themselves heard in an endeavor to influence our government to act along lines which the administrators of the United States not only consider reasonable but absolutely essential?

Convention of Road Builders' Association

IT has been decided to hold the fifteenth annual convention of the American Road Builders' Association at the Hotel Statler, St. Louis, Mo., during the week February 4 to 7, 1918. In view of the influences that have hampered highway construction during the past year or more and the vital need of a system of road transportation to relieve the already overburdened railways, the coming meeting promises to be the most important in the history of the organization.

In selecting the convention city, the directors of the association took into consideration the conditions surrounding road building at the present time and decided that because of the vitally important problems to be considered, a great national gathering of men interested in highway construction and maintenance should be held at some central point where a large attendance could be secured without undue inconvenience. St. Louis was chosen because of its facilities for handing a gathering of this character and also because of its location close to the centre of population.

Owing to the difficulties of railroad transportation, it is felt by the Association that it should make no plans which would in any way interfere with the transportation of materials needed for war purposes. It has been decided, therefore, to abandon for this meeting the great exhibition of road building machinery, materials and appliances which, for a number of years, has been an important feature of the Association's conventions, and to limit the good roads show in connection with the forthcoming convention to such display of materials, models, photographs, literature, etc., as can be shown in the large ball room of the Hotel Statler. Another year, it is hoped that conditions will warrant the usual exhibition of machinery and materials.

While the convention program is only in a formative stage at present, sufficient acceptances have been secured to assure the attendance of speakers of international reputation in their respective lines. In addition to the technical men, it is planned to have leaders in financial and business circles address the convention on the commercial side of road building and, if conditions permit, it is expected that government officials will also speak. The aim, in fact, of the committee in the preparation of the program will be to emphasize the importance of road improvement not only as a state and nation-wide problem, but as a vital factor in national preparedness.

City Management as a Profession

AT the recent annual meeting of the City Managers' Association a very interesting committee report on city management as a profession was submitted by Mr. H. M. Waite, City Manager of Dayton, Ohio. A synopsis of this report follows:

Commissions have made city management a profession by showing a willingness to go outside of their own communities for city managers. City managers are receiving invitations to other towns and there now have been seven cases of transfer, showing that the tendency is to recognize the existence of professional experience. City managers recognize that a career lies before them in this field and are seriously building up their experience to make it a life career.

The profession can be said, therefore, to have come into existence with every indication of continuance. It is interesting to note from the registration at the city managers' convention this year that out of 25, about 95 per cent. are engineers, indicating that commissioners turn to the municipal engineer for managers.

Qualifications for City Managers

Small cities (under 20,000 population), preferably engineer, executive ability is first essential. Larger cities (20,000-200,000 population), executive ability first essential, engineering less essential. Large cities (over 200,000 population), executive ability prime essential.

The committee believes that city manager qualifications may be from present experience, classified as follows:

Experience shows that actual experience is considered as most valuable equipment.

The attempt to lay out courses by universities for training city managers is handicapped by the fact that a major requirement is native executive ability, which cannot be taught. A university cannot train a man to be an ordinary business executive. It cannot propose a man to step into the management of a city. It can train him to step into the management of a village. The attempt to lay out a course reveals the fact that the entire field cannot be covered by thoroughness in every branch that confronts a manager.

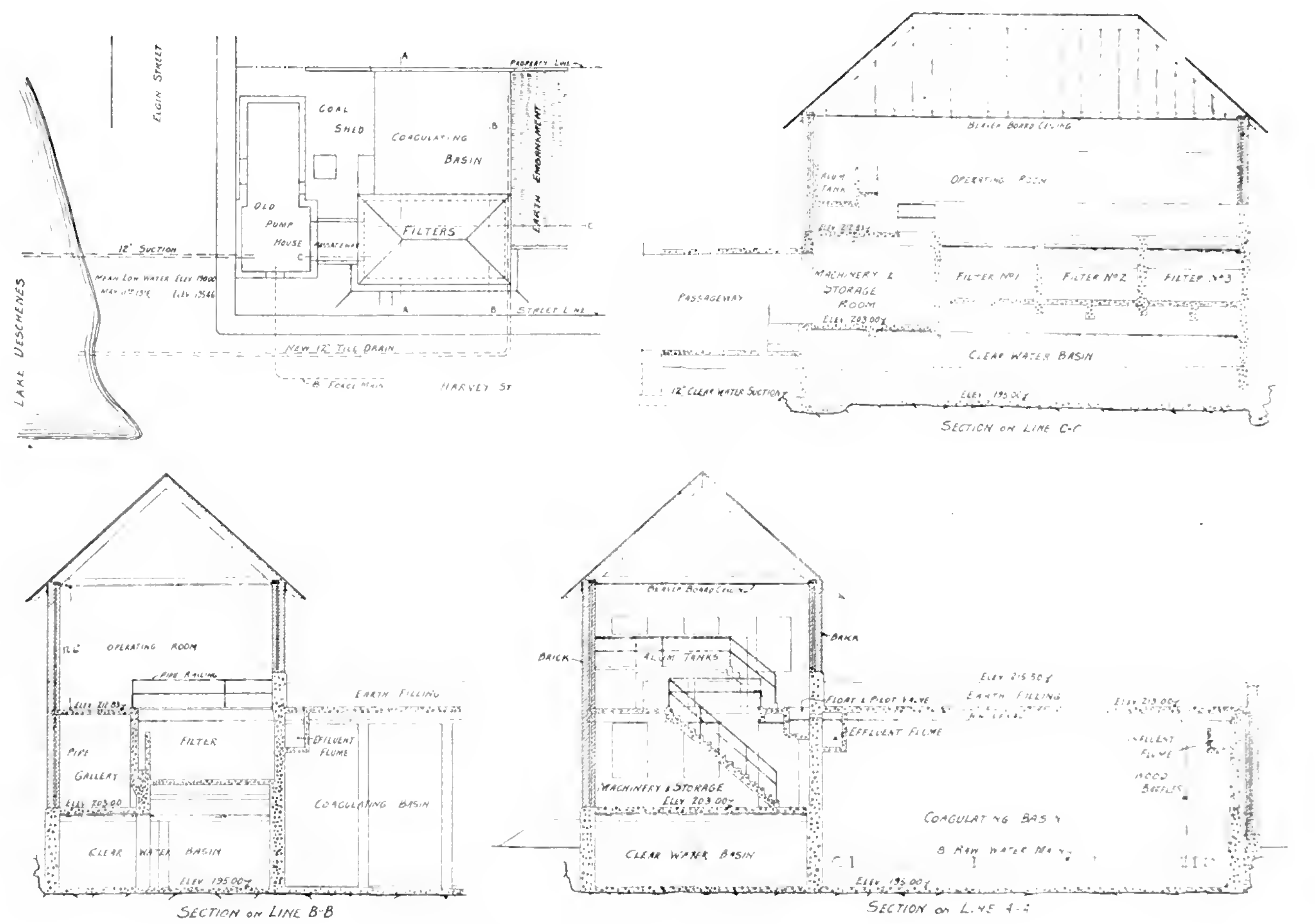
It is essential, therefore, that rather than give a man a smattering of all the many subjects, that he be thoroughly trained along some one or two lines, such as engineering or accounting, or whatever may be his natural bent, the balance of his time in college, being devoted to obtaining a general knowledge of the other fields.

Tests on Mechanical Gravity Filtration Plant at Aylmer, Quebec

Satisfactory Purification of Ottawa River Water—Plant Uses Crushed Marble Mixed with Silica Sand for Filter Beds

By H. L. Seymour, B. A. Sc., A. M. Can. Soc. C. E.

AN analysis of modern filter plants, as exemplified by the new plant at Aylmer, Que., shows that they ordinarily consist of several distinct features, viz., coagulating basin, filters, clear-water basin, pipe gallery, chemical storage space and operating room. Of these the coagulating basin, clear-water basin and filter units are usually, as in Aylmer, several months apart, while the water, divested to a greater or lesser degree of these impurities, spills or overflows to and upon the filter beds, which are situated exterior to and lower than the coagulating basin. Within these filter tanks superimposed upon a manifold system of piping connected to a screen system are the beds of gravel and sand, the filtering media.



Layout of Aylmer filtration plant and sections showing construction.

constructed of reinforced concrete. The operation of a typical gravity plant is substantially as follows:—

The raw, unfiltered water is lifted by means of low-service pumps to the coagulating basin. The supply from the pumps has injected into it a measured quantity of sulphate of alumina. This coagulant, because of the presence in the water of the carbonates of lime, etc., decomposes into an insoluble coagulum, hydrate of alumina being formed. The coagulated water leaves behind it in the coagulating basin the coagulated, suspended impurities to a greater or lesser degree, and these impurities accumulate upon the bottom of the tank which consequently requires cleaning at periods

These filters are elevated to a height to allow for sufficient head above the clear-water basin so that a requisite amount of water may pass through them, the rate of flow as ordinarily practised being 1.00 imperial gallons per minute per square foot of area.

Details of Aylmer Plant

Certain details of the Aylmer plant are given in the following tabular statement:

Constructed—1917.

Source raw water—Ottawa River (widened at this point to Lake Deschenes).

Source of power Direct connected electrically-driven centrifugal pumps with steam standby.

Coagulating basin—40 feet by 18 feet wide, 16½ feet deep divided into two parts.

Coagulating basin period—4 hours when plant is operating at full capacity.

Lineal velocity through basin—2 inches per minute.

Capacity—830,000 imperial gallons per day, 3 filter units.

Rate of filtration—1.66 gallons per square foot per minute.

Clear-water basin—Over 40,000 imperial gallons.

Ottawa River water at Aylmer receives pollution due to the discharge of municipal and private sewers located at various points above the municipal intake, and also from the Aylmer sewer outlet itself, though it is located below the water intake. This latter pollution is due to the fact that the sewage is sometimes carried up-stream by winds which create a flow in that direction stronger than the natural velocity of the current. Ottawa River water is soft and though highly colored is, generally speaking, low in turbidity. The water in many respects is nearly ideal for all domestic and manufacturing purposes, and if it were not for the fact that pollution enters the river at various points, it would be a safe water for drinking purposes. Because of the comparatively high color content of the Ottawa River water, mechanical or rapid sand filtration is the most efficient method of purification for this supply, and was one of the reasons for the adoption of this type of filtration for the town of Aylmer.

Filters on One Side of Gallery

It is the purpose of this article to describe in some detail those features in which the Aylmer plant now in successful operation for a couple of months differs from similar plants.

The usual layout of a filter plant is to place filters on both sides of the pipe gallery. This means economy in piping, but unfortunately also complication in piping and restricted access to the pipe gallery. In the Aylmer plant there being but three filters they are all conveniently placed on one side of the pipe gallery (see section). This gallery is consequently easily accessible, is well lighted by windows with the result that leaking valves or other mishaps are readily attended to.

Crushed Marble for Filter Beds

The writer understands that during the development of mechanical filtration there have been tried for filtration material: excelsior, sponges, composition stone, cotton fibre, charcoal, coke, quartz, etc. Graded gravel and silica sand are the media now generally used. In the Aylmer plant the filter beds consist of the usual layer (9 inches) of graded gravel, but of the remaining 27 inches of filtering material only two-thirds is silica sand, the other third being crushed marble. Both sand and marble have an effective size of .45 mm. and a uniformity coefficient of 1.65. While crushed marble has been used for several years in pressure filter installations, it is a new development to use it in a gravity plant. The writer believes that this is the first time that it has been done, at least in Canada.

The function of the crushed marble is twofold, to prevent by chemical action the presence of free alum in the filtered water and to correct any excess of carbon dioxide.

Continuous Run Without Passage of Suspended Matter

The guarantees required from the contractor who erected the Aylmer plant were similar to others for contracts which have been previously awarded in Quebec Province and throughout the Dominion, with the exception of one clause. This clause required that the contractor specify the period of time for a continuous run of the filter without the passage of aluminium hydrate or suspended matter, the presence or absence of hydrate to be determined by an examination of the filtered effluent and the hydrate or suspended matter not to be visible to the naked eye after the sample has stood for twenty-four hours. It is apparent that when hydrate or suspended matter is passing a filter, objectional bacteria may also be found in the filtered water. Under such circumstances the efficiency of the filter is reduced and a heavy charge of chlorine is required for adequate sterilization. The contractor's guarantee was for only a 12-hour continuous run without the passage of hydrate. The results of the official tests recently made on the Aylmer plant by the Quebec Board of Health would indicate that the crushed marble in this respect is more than fulfilling expectations.

Condition of Ottawa River Water

From the report of the Ottawa Pure Water Commission, dated November 25th, 1911, the following extracts are taken:

"No system of sand filtration, either simple or multiple, without chemical treatment, is capable of removing the color and the excessive amount of organic matter in the Ottawa River water.

"The color and excessive dissolved organic matter in the Ottawa River water may be removed by suitable chemical treatment followed by filtration. The water so obtained will be in general of good quality. This process is widely and successfully used in various American cities.

"Water so treated will dissolve iron from the pipes and the iron will afterwards separate and give rise to complaints."

The last paragraph quoted refers to the "red water trouble," of which opponents to mechanical filtration make so much. The action of the coagulant, sulphate of alumina, results in the reduction of the alkalinity of a water by a certain amount and in the increase of free carbon dioxide by about half that amount. In other words, the filtered water is more acid than the raw water. This, it is claimed, may cause a corrosion of pipes. "Under some circumstances the liberation of carbonic acid seems to increase somewhat the rate at which clear filtered and oxygenated water corrodes certain forms of uncoated (unprotected) metal. It is not a factor to be regarded with apprehension because the conditions are no more conducive to corrosion than are found in some of the best ground water supplies of the country. If thought advisable, this carbonic acid may be removed by the addition of lime," says George A. Johnson in his "Present Day Water Filtration Practice." It is of particular significance that for the great Catskill supply for the city of New York, the majority of engineers consulted recently advised in favor of mechanical instead of slow sand filtration of the water supply. But the red water trouble, if it be a trouble, is obviated in Aylmer by the presence of the crushed marble in the filters, which increases the alkalinity and reduces the free carbon dioxide by very substantial amounts.

Results of Tests

The information that follows was compiled from the results of official tests on the Aylmer plant, the analytical work being done by the laboratory of the Superior Board of Health of Quebec:

Summary of Third Test, November 21-22.

Source	Color (Parts per million)	Alkalinity (Parts per million)	Bacteria per C.C. 20°C.	B. Coli Percentage Frequency 0.1 c.c.	1 c.c.	10 c.c.
Raw	74-72	20	215	42	64	100
Settled	11	5	19		26	40
Filter No. 1	9	9	7		2.2	0
Filter No. 2	9	9	1.5		0	5.5
Filter No. 3	12	9	1.5		0	8
Filtered and Treated	10	10	2		0	0

The various parts of the filtration plant were measured and were found to conform with the dimensions as specified on the plans. The capacities of the four pumping units were gauged and it was found that in every case the specified capacity was exceeded by a safe margin. Previous to the operation of the filter plant the several concrete basins were tested for water-tightness and they all proved to be very satisfactory.

It was noted during the several tests that the filters took on head more rapidly (a desirable feature) than other filters operating on Ottawa River water, and also that the filters were hard and compact at the end of the filter run, a condition that does not obtain with other filters handling this same water at other places. The filters also completed their run, that is, ran out to 9 or 10 feet loss of head, without passing aluminium hydrate in the effluent, even after the samples were examined 24 hours after collection.

During the tests it was noted that the presence of the crushed marble in the filter media increased the alkalinity of the filtered water 80 per cent. over the alkalinity of the settled water, and that the free carbon dioxide content of the filtered water was reduced 50 per cent. as compared to the settled water.

From information secured during the tests it would appear that the filters require to be washed only after 20 to 24 hours of continuous service when the filter plant is operated at full capacity. If runs of that period are obtained the wash water averages from 1.8 to 2.2 per cent. of the total amount of water filtered, or much less than the contractor's guarantee (not to exceed 5 per cent.).

During the tests 2.4 grains of coagulant per imperial gallon were applied to the raw water.

The tests would indicate that the plant is very satisfactory in every respect. In the table there is given a summary of the analytical results of one of the tests.

The cost of the plant was approximately $38,000. The contract was carried out by R. T. Smith Company, of Montreal. Detailed plans and equipment were furnished by the New York Continental Jewell Filtration Company, all work being under the supervision of Mr. Jas. O. Meadows, of Montreal, consulting engineer for the town of Aylmer.

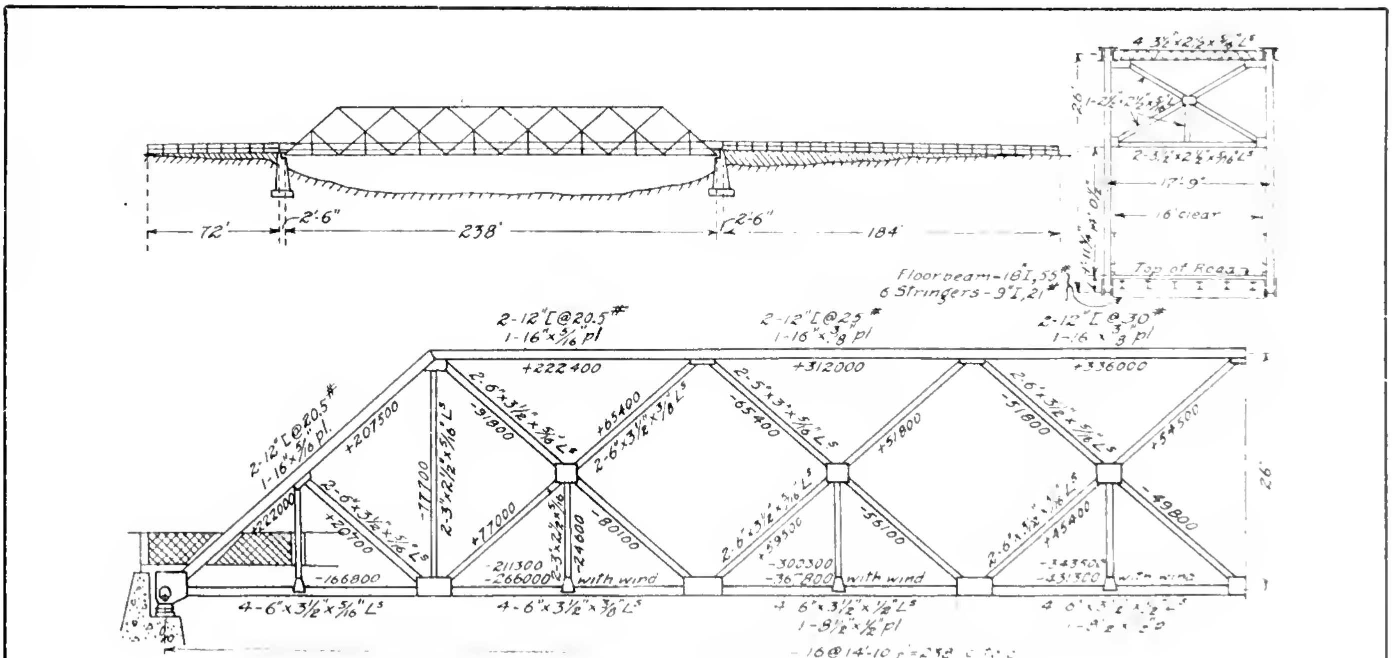
Ste. Julienne Highway Bridge

A 238 ft. Steel Span Built on Quebec Government Specifications—Wood Floor—Fill Approaches

By P. L. Pratley*

THE Ste. Julienne highway bridge consists of one 238 ft. span over the River Ouareau, between the municipalities of Ste. Julienne and St. Liguori in the County of Montcalm, Que., a few miles northwest of Joliette. The span is of the usual Dominion Bridge Company type designed to meet the requirements of the Quebec Government specifications and provides for a 16-ft. clear roadway between wheel guards. The floor is of wood, two layers of 2-in. plank being specified, and this is carried upon steel stringers, framed into the floor beams. The truss design is of a double intersection parallel chord type, 26 ft.

*Designing Engineer, Dominion Bridge Company.



Stress and material diagram of 238 ft. steel span on Ste. Julienne highway bridge.

deep between centres of gravity of chords and with 16 panels of 14 ft. 10½ ins.

The loading, as shown on the accompanying stress and material diagram, includes 1,100 lbs. per lineal foot for the dead load of steel and wood, 64 lbs. per sq. ft. of the roadway for the live load on the trusses, and for the floor members provision has been made to carry a 15-ton wagon on a 6 ft. x 8 ft. wheel base. In the case of this bridge the wheels were considered to be of equal load but more recently the specification calls for two-thirds of the total load being carried to the rear axle. The specification for unit stresses, impact and general detail is that of the Quebec Government, issued by Mr. L. A. Vallee, Provincial Engineer of the Department of Public Works and Labor, and duplicates, in general, the Dominion Government specification, issued by the Department of Railways and Canals.

Fill Approaches

The steel work rests on two new abutments, which in turn are founded on piles, the concrete being about 18 ft. deep and 8 ft. thick above the footing course, the width being sufficient to accommodate the bridge seat at the top and the sides being battered at a conventional slope. The approaches are newly-made embankments and the road is fenced in, as shown on the general elevation, by gaspipe railing at each end of the bridge. On the span the fence consists of lattice steel work, fitted in to the truss, while wheel guards are made in the usual way, from 6 x 4 in. timbers, set up 2 ins. clear from the floor. Nailing strips are bolted to the six lines of 9-in. I-beam stringers and the floor spiked in transverse and diagonal layers above these. The floor beams are 18-in. I-beams at 55 lbs., riveted in to the truss members at the panel points. The truss system, while theoretically statically indeterminate, is of a very usual type in Quebec Province and provides a structure that is satisfactory from the point of view of stiffness and economy, as well as being reasonably pleasing in appearance.

The steel was shipped to Montcalm on the C. N. Q. Ry., several miles west of Joliette, and from there teamed to the site, some five or six miles, and the bridge was erected in August, 1917. The total weight of steel in the structure is about 97 tons, to which must be added about 9,000 lbs. for gaspipe railing, and about 1,000 lbs. for protection plates on the piers. There were no unique or unusual features in connection with the work. The drawing herewith shows the general elevation and also a stress and material diagram with a cross section of the floor.

Difficulties in Construction of Toronto-Hamilton Highway

By Geo. H. Gooderham*

On the Toronto-Hamilton highway as constructed, a roadway of from 12 to 15 ft. has been graded to a minimum width of 26 ft. Many hills and hollows have been improved. The maximum grade has been reduced from 10 to 4 per cent. More than 50 bridges and culverts with spans up to 50 ft. have been reconstructed or enlarged. More than 35 miles of tile drains have been laid. Many improvements in location have been introduced—bad curves have been eliminated or improved—telephone, telegraph and hydro poles, radial tracks and other obstacles have been removed. The cost of the road surfacing represents approximately only 50 per cent. of the total cost. In fact, much of the work done should be considered as done for all time to come. The increase in width of pavement from 16 to 18 and 24 ft. has increased the total yardage by almost 20 per cent. The statement was based on the completion of the work in 1915, and the Commission's contracts were placed with that idea in mind. The work has been done by day labor and the Commission has had to increase its hourly rate for labor by 75 per cent. The market price of the most important materials has increased by nearly 60 per cent. The cost of commissary supplies has almost doubled. Some of the other supplies have cost nine times as much as in 1914. None of us have ever seen a similar change in conditions in such a short period.

* Chairman, Toronto-Hamilton Highway Commission.

Wet Weather Hampered Progress

The chief engineer of the Toronto and Hamilton Highway Commission reported November 4, 1914. Our instructions to him on account of the pressing needs of the unemployed were to start actual construction as quickly as possible. The first work was done November 8. Grading continued during the winter, gangs being changed fortnightly in order to offer some work to as many men as possible. Serious difficulties arose in connection with the securing of proper yard accommodations, the railway being slow to allow anything which might interfere with traffic on the busy Toronto to Hamilton section. While it was intended to have the yards in shape to operate by January, 1915, they were not ready until July. This fact seriously inconvenienced progress in 1915, for it prevented the opportunity to store sand and stone during the early spring before the laying of the concrete had been begun. Limited quantities were stocked, and the first concrete was laid on July 21.

An unprecedented period of wet weather occurred, as it rained on 37 of the 40 days following July 15. (Saint Swithin's Day). Many of the storms were very heavy, that on August 4 being the heaviest known for more than 50 years. They greatly hampered our own work, and made it practically impossible for sand pits to be operated. Conditions improved in September, however, and on account of an unusually mild fall, work was continued until well into November, about 16 miles of concrete being laid—the most important stretches extending from Burlington to Hamilton and from Oakville to Clarkson. Almost all of the heavy grading west of the Etobicoke was completed this season.

The maximum number of men employed was at times slightly in excess of 1,000, but up to the end of 1915, 3,983 men had applied to the Commission for work and 3,430 had actually been employed. Until late in the season only British subjects were engaged. Before the end of the year almost 300 had left to join overseas regiments. The only work carried on through the winter was the replacing and extending of bridges and culverts.

Strong Competition for Labor

The spring of 1916 was cold and wet, the weather not settling until June 21. Sufficient stocks of sand and stone were on hand, however, and the work west of the Etobicoke would have been completed earlier in the fall if labor shortage had not interfered seriously with the regularity of the cement shipments. The working force this season did not exceed 600 men and many of these were drawn from northern Ontario only after the most strenuous efforts. It was not unusual for as many as twelve representatives to be in the field at once competing for the men. Some of the contractors were from as far east as Halifax. After they reached the work they had to be held in competition with the manufacturers in both Toronto and Hamilton.

Stone Embargo Caused Delay

Weather conditions in the spring of 1917 were again very unfavorable to outdoor work. Rain fell almost every day until July 19. The wet weather in combination with the heavy clay soil and the network of newly filled trenches interfered very seriously with the progress of the grading. In addition, the work on the New Toronto sanitary sewer moved along very slowly, and as the portion undone was just opposite the Commission's yard the Commission itself finally completed the backfilling of the trench in order that concreting materials could be hauled to the roadway and the laying of the concrete begun.

The first mixer was started July 18. The weather now settled, and good progress was being made, until like a bolt from the blue sky came the order restricting the use of cars in the stone trade. The Commission urged the necessity of finishing up the roadway this season, but could not urge its claim in opposition to that of the people of Canada, for coal. Three weeks of ideal weather were lost before stone shipments were resumed, and the opening of the roadway delayed for at least that period.

Building Outlook in Montreal

Generally Speaking, this Year's Important Work Has Been Outside the City—Prospects for 1918 Not Particularly Encouraging

THE building season in Montreal, now practically closed, is not one on which contractors can look back with satisfaction, and had it not been for work in outside districts, contractors would have had a very lean year. Generally speaking, the most important jobs have been outside the city, firms thus following a lead obtained in the previous year. The following instances may be cited:—Parliament Buildings, Ottawa, P. Lyall & Sons Construction Co.; Lennoxville College, John Quinlan & Co.; St. Maurice Paper Company's plant, Three Rivers, and Quebec elevator, Geo. A. Fuller Co.; Canadian Aloxite Company's plant, Shawinigan Falls, the Church, Ross Co., Ltd.; Lindsay Arsenal, Westinghouse, Church, Kerr & Co.; International Nickel Company's plant, Port Colborne, Ont., dam at Coaticooke, sewer contract at Amherstburg, and bridge work at Campbellford, Ont., the Foundation Co.; Canada Starch Company's factory at Cardinal, Ont., and Merchants Bank branch at Prescott, A. F. Byers & Co.; Military Hospital, St. Anne de Bellevue, and addition to plant of John Bertram & Sons, Dundas, Ont., E. G. M. Cape & Co., Ltd. A portion of the work named was secured during an earlier period, and some of it not yet completed. One of the largest undertakings of its kind, La Loutre dam, the contract for which was held by the St. Maurice Construction Company, is now finished, while Fraser, Brace & Company are carrying out an extension of the Cedars Rapids power plant at Cedars, P.Q. A dam for the city of Sherbrooke and a dam and buildings at Joliette, for the Howard Smith Paper Co. were built by MacBean & Williams.

Decrease in Permits

The Montreal permits show a decrease for the eleven months of $706,000. In point of value, the chief city work has been the building of a C. N. R. station, the excavtion for a large depot to be built later on, the building of a street bridge, and making the connection with the Mount Royal tunnel. This is still in progress. The construction of Loew's theatre, the rebuilding of the Princess Theatre, and other work for amusement purposes contributed a fair share to the programme of the year.

Other work included the construction of a large munitions plant, a ten-storey warehouse, box, tobacco, motor, can, and shoe factories, a foundry equipped with electric furnaces, shipbuilding plant, steam plant for the Montreal Tramways Company, the completion of the Ross Memorial addition to the Royal Victoria Hospital, and the building of several schools and churches. Further work has also been done on the Montreal aqueduct, but this has now ceased, the contractors and the city having agreed to arbitrate their differences.

Contracts for filtration plants outside the city are being carried out by Montreal firms. These include plants at St. Hyacinthe, Pointe Claire, Dorval, St. Johns, and St. Anne de Bellevue, while an extensive waterworks scheme is now being laid out at Montreal South by a Montreal firm.

A considerable number of flats and houses have been erected, but the supply is still unequal to the demand. Prices of all materials and also labor have again advanced, and certain classes of material have been difficult to obtain. Labor was scarce, with the inevitable result of demands for higher wages. As far as can be judged, materials will continue to be in short supply, and lumber in particular will certainly advance.

Prospects for 1918

It will be seen that architects have had an unremunerative twelve months so far as the city of Montreal is concerned, and were it not for the school and church work there would have been practical stagnation. Engineers, too, have had for the main part comparatively little work, there being no jobs of any outstanding importance in the city, although a fair amount of work for outside points has come to hand.

Prospects for 1918 are not particularly encouraging. Although some projects are contemplated, it is doubtful whether a majority of them will go ahead. Certain work of a pressing character and several schools will be given out—and if the advice of Mr. J. P. Anglin, the president of the Builders' Exchange, be taken, some of the other contemplated buildings will be put in hand at once, rather than a waiting policy adopted. Mr. Anglin says "build now," and do not wait for a reduction in values, which may not materialize.

The Herbert Morris Crane & Hoist Company, Limited, formerly of 79 Peter Street, Toronto, have sent out notices that their new plant at Niagara Falls is in operation and that they are in an excellent position to give prompt shipments of chain blocks, trolleys, travelling chain blocks, jib cranes and overhead travelling cranes. The extra manufacturing facilities available at their new works at Niagara Falls will provide better service than ever before. Correspondence in future to be addressed to Niagara Falls, Ont.

Canadian Society of Civil Engineers Broadens Out Under New Name

As "The Engineering Institute of Canada" It Will Aim to Embody All Classes of Engineers on the Same Footing

THE Committee on Society's Affairs of the Canadian Society of Civil Engineers have now made their report, revising the by-laws and making a number of recommendations as to the wording and scope of the by-laws, the change of name, etc. The report has been approved by the Council of the Society.

The Committee, in the course of the report, state:

The proposed revision of the by-laws is recommended by the Committee as a re-arrangement and re-wording, which co-ordinates the amendments made from time to time, and the committee considers it a desirable improvement on the present laws. It also includes modifications which carry out the ideas developed in the Committee's discussions for the promotion of the interests of the society.

Many Clauses Made More Definite

By-law No. 1, "Objects," includes a clause "to promote their professional interests," and the clause, as a whole, has been re-worded to bring it more closely in line with what we consider to be the objects of the Society.

In sub-division "Membership," qualifications have been added for "professional charge" and "professional responsibility," which will define the position of university professors more accurately.

By-law No. 5 is re-drafted to permit of the organization of a Montreal branch without further alteration.

Under sub-division "Officers," a change in the number of councillors corresponds to the change which is made in the geographical districts, which it is proposed to call "electoral districts." The method of filling vacancies is changed and vacancies will only be filled until the next annual election.

Under sub-division "Management," the secretary, who is now a salaried officer, will hold office at the will of the Council and his duties are clearly defined.

Publication of Papers

The duties of the Publication and Papers Committee are more closely defined. Attention is called to the Papers Committee being composed of representatives from the branches, i.e.—of men in touch with the membership as much as possible, who will endeavor to obtain papers, and the Publications Committee being composed of another set of men who will be selected on account of their competence as judges.

It is hoped that the acceptance of papers for advance publication or for printing in the Transactions will be regarded as an endorsement of merit and a recognition of the author.

In subdivision "Admission, Transfer and Expulsion of Members," a clause is introduced to agree with the law in the province of Quebec and slight changes are made in wording which are considered an improvement on the present by-laws.

In subdivision "Fees," no change is proposed except in the Clause "Arrears," which has been drafted to conform to that of the American Society of Civil Engineers with slight modifications.

District Meetings

In subdivision "Meetings," an important, and the Committee believe, a most promising innovation is made. It is proposed that the annual meeting shall be considered as the general business meeting of the Society, but general professional meetings of the Society are to be arranged for in various districts, conducted by the members resident in those districts. Such meetings will provide a means of presenting papers before the Society as a whole and, it is anticipated, of encouraging our membership to meet, visit works, improve their acquaintance and, in general, increase their interest in the Society. Such meetings will also have the effect of bringing the Society more before the public and should assist in increasing the knowledge which the public at large possess of the work of this Society. The Committee feels that, on account of the great extent of Canada, meetings could be advantageously held which would not be restricted in any way to the local membership, as they would be open to the membership at large but would be conducted by its local officers, assisted by the Secretary of the Society so as to ensure their success.

Change in Organization

In subdivision "Branches" and "Provincial Divisions" the by-laws referring to Branches and Provincial Divisions must be considered together as they include important changes in the constitution. The committee has endeavored to define an organization which will meet the following requirements:

(1) The Society should be equally desirable and valuable to engineers belonging to any branch of the profession.

(2) Without discussing the question of whether the Society would best promote the interests of its members by working for an open or a closed profession, a discussion which the Committee recommends should not enter into the consideration of the proposed by-laws, the Society should afford a means through which its members may represent the engineering profession either locally by a branch, or provincially, by a provincial division. The Committee considers that the important factor in the development of the Society is the branch, and the by-laws are drafted on the assumption that a Montreal branch will be formed and that headquarters meetings of the Society will be abolished, although the premises will be available for the annual meeting of the Society, any general professional meetings of the Society which may be held in Montreal and for the meetings of the Montreal branch.

No rebate of fees is made to the Montreal branch, nor is any change made in the fees of the resident membership, so that the present financial arrangements are in no way disturbed.

Abolition of Headquarters Meetings

The sections which previously existed at headquarters are abolished and in their place the branches may organize sections within themselves wherever such sections can be advantageously established to afford engineers belonging to any branch of the profession an opportunity to meet together and discuss papers or exchange views on subjects they are particularly interested in.

The sections may vary in size or enterprise, but to ensure all engineers feeling that their branch of the profession is regarded in the same light as any other, the sections in any branch should be placed on an equality with respect to their organization.

Apart from the organization of the sections in the branches, these by-laws recognize no difference between engineers, whether mechanical, civil, electrical or belonging to any other branch of the profession. They are all engineers. If elected to office, they are all representative of the engineering profession and not of any branch of it. It is considered that this arrangement will increase the opportunity for local development. A branch is in a position to attract engineers of every kind and afford them an opportunity to meet together with other engineers engaged in the same line of work.

All Engineers on the Same Footing

Apart from their professional meetings all engineers are on the same footing in the branch, and the branch is thus in a position to represent the engineering profession as a whole, and the branches and engineers resident in a province can, through the formation of a provincial division, represent the engineers in their province as a whole.

The rebate for the branches has been made twenty per cent. as upon investigation this was found to be sufficient.

In subdivision "Nomination and Election of Officers," the present geographical districts have been revised and re-arranged and called "electoral districts," as they only exist for the nomination and election of officers. The by-laws are so arranged that the Councillors are only selected by the votes in their own electoral districts, although they are nominated by the nominating committee as a whole, which should tend to bring forward the best class of men for an office. Several other modifications in the by-laws which were considered desirable have been included.

In subdivision "Amendment," a new clause is presented which it is thought will be satisfactory. It provides an opportunity for amendment to be accepted in the form desired by the proposer, yet prevents an amendment being modified in a haphazard way at the annual meeting. This clause is the result of a great deal of study on the part of the Committee and they believe it is worthy of a careful trial.

In conclusion, the Committee earnestly suggests that if these by-laws are approved by the Council, the corporate members be requested not to object to them as a whole, on the ground of any particular clauses which may be objected to by any individual members, but that if as a whole they are considered desirable, the corporate membership be requested to adopt them and subsequently introduce amendments to modify any particular clauses which they consider should be modified or improved upon.

Change in Name

The Committee discussed at length the pros and cons of a change in the name of the Society, setting forth the advantages and disadvantages side by side. They conclude:

The Committee having considered all the arguments, feels that a change of name to "The Engineering Institute of Canada" is desirable.

The reasons therefor are as follows:—

(a) "Engineering" is broader in scope than "Engineers," and is not so likely to be misinterpreted by the public at large.

(b) The word "Institute" carries no suggestion of fraternal and benevolent organizations possibly implied in the word "Society" and is a very similar form to that of the parent body, the "Institution of Civil Engineers," and exactly the same form as the most recently incorporated professional body, the "American Institute of Consulting Engineers."

(c) The words "of Canada" appear preferable to "Canadian" as being broader and as belonging in the Dominion.

(d) "The Engineering Institute of Canada" appears to be perfectly wide in its scope, perfectly general in its application to the engineering profession, and distinctly belonging to and in the Dominion.

(e) The abbreviation of the proposed title, (E. I. C.), is not objectionable in any way, and is in the shortest possible form. The combination used as designating membership is also free from objection, as "M.E.I.C." or "A. M. E. I. C."

Nominees for Office in the C. S. C. E. for the Coming Year

The Nominating Committee of the Canadian Society of Civil Engineers have made the following nominations for election as officers and members of Council at the annual meeting:

President, H. H. Vaughan, Montreal; vice-presidents, H. E. T. Haultain, Toronto; R. F. Hayward, Vancouver; J. G. G. Kerry, Toronto, and C. H. McLeod, Montreal.

Councillors, District No. 1:—C. H. Bristol, Ernest Brown, J. M. Robertson, O. Lefebvre, all of Montreal; District No. 2, W. A. Duff, Moncton, and D. H. McDougall, Sydney; District No. 3, N. E. Brooks, Sherbrooke, and Hon. G. R. Smith, Thetford Mines; District No. 4, John Murphy and Alex. Gray, Ottawa; District No. 5, L. M. Arkley and Peter Gillespie, Toronto; District No. 6, G. D. Mackie, Moose Jaw, and L. A. Thornton, Regina; District No. 7, A. E. Foreman, Victoria, and E. G. Matheson, Vancouver.

Henry Hague Vaughan, the Prospective President of the C. S. C. E.

MR. Henry Hague Vaughan, the nominee for president of the Canadian Society of Civil Engineers for the year 1918, is the third vice-president and a director of the Dominion Bridge Company, as well as president of the Montreal Ammunition Company, vice-president and manager of the Dominion Copper Products Company and vice-president of the Albany Car Wheel Company. He was born in Forest Hill, England, in 1868, and was educated at Forest House School and King's College, London. Before coming to the United States in 1891, he had experience in railway works of the old country. He was with the Great Northern Railway until 1898, when he became mechanical engineer of the Q. & C. Co. and Railway Supply Co., of Chicago. He became assistant superintendent of shops with the same companies in 1899, and for two years following 1902 was assistant superintendent of motive power on the Lake Shore and Michigan Southern Railway, Cleveland. He joined the Canadian Pacific Railway in 1904 as superintendent of motive power for eastern lines, becoming assistant to the vice-president in 1905.

Mr. H. H. Vaughan, who will be President of the Canadian Society of Civil Engineers for 1918

He resigned this position in 1915 to accept the presidency of the Montreal Ammunition Company.

Mr. Vaughan is a member of the Institute of Mechanical Engineers, a member of the Canadian Society of Civil Engineers, of which he was councillor in 1910, and a member of the American Society of Mechanical Engineers, of which he was vice-president 1910-1912. He was also president of the American Railway Master Mechanics' Association in 1908. He is a past president of the Montreal Engineers Club and also of the Canadian Railway Club.

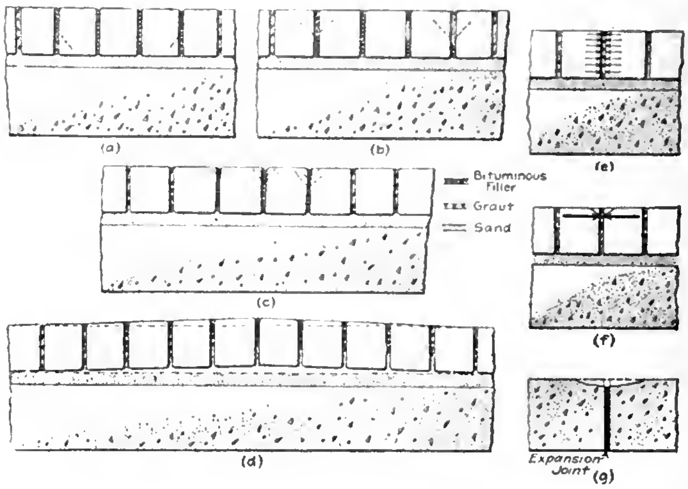
Damaged Government Property at Halifax Being Replaced

HON. J. D. Reid, Minister of Railways & Canals, and Hon. F. B. Carvell, Minister of Public Works, have been making arrangements for the reconstruction of the property of the several government departments recently wrecked in the Halifax calamity. Hon. Dr. Reid states that the damage to government property has been very extensive and includes the railway station at North Street, the roundhouse, car shops, freight sheds, wharves, piers, naval buildings and drydock buildings, as well as the station and freight shed at Dartmouth.

The two large contracting firms doing work on the Halifax ocean terminals, Cook Construction Company and Foley, Welch, Stewart & Fauquier, have offered the services of their staffs and plants in any capacity. This offer has been accepted by the government. As a result of this, Mr. H. F. McLean, general manager of the Cook Construction Company, has placed several hundred men at work with a view to arranging accommodation for several hundred railway employees within a couple of weeks, and the reconstruction of buildings of a capacity equal to that of the former structures for both freight and passenger accommodation, to be ready within five or six weeks

Many Pavement Failures Due to Concentrated Pressure

THE initial cause of many defects and failures in rigid pavements, such as brick with cement filler and cement concrete pavements, can be explained by considering them as the result of an abnormal concentration of pressure. As an example: Take a single English walnut in one hand and you may not be able to grip hard enough to crush it. In fact, you may not be able to crush it by using both hands. But take two English walnuts in the hand and you will be readily able to crush one of them. Nor is this hard to explain. In the first instance the flesh of the hand distributed the pressure over a considerable area of the shell of the nut, but in the second instance the entire pressure was concentrated on a very small area of the nutshells which were in contact one with the other. This concentra-



Concentration of Pressure Manifests Itself in Many Ways

(a) Poured transverse joints with grout at bottom. (b) Same; grout applied after pouring pitch. (c) Pebble wedged between brick. (d) Lower portion of joints filled with sand from cushion causes "heaving" under some conditions. (e) A full joint distributes pressures resulting from expansion, while (f) spalling is precipitated by uneven filling. (g) Concrete pavement joint set below finished surface.

tion of pressures, and not the intensity of the gripping force, was the cause of the failure.

Frequently a failure of a cement grouted brick pavement can be explained in this manner if the joints have only been filled for a short distance from the top. Were the pressure causing the failure distributed over the whole face of the brick, it would be able to withstand the destructive forces, but the concentration of the same total pressure on a small portion of the depth is sufficient to crush that part of the brick. The explanation is advanced in an article by A. H. Hinkle, in Engineering News-Record.

Partial filling, therefore, usually results in spalling off and crushing the wearing surface of the brick and grout filler. This may occur in small patches or over larger areas, depending upon the distribution of the inadequate filling. An examination of the small patches that have failed in an otherwise satisfactory grout-filled brick pavement will usually reveal the fact that a large percentage of the failures are concomitant with an insufficient filling of the joints. In sandy countries it will be found that sand will drift into the joints after the brick are laid and before the grout filler is applied. If the brick are disturbed after they have been placed on the sand cushion there will result an upward movement of the cushion sand, and furthermore leaves blown into the joint in the fall of the year will be found to be another source of trouble when an attempt is made to completely fill the joints with cement grout.

Crushing at Expansion Joint

The almost universal recurrence of crushed brick along the transverse expansion joint in a brick pavement is largely traceable to the concentration of the pressures over a small area of the brick. It must be admitted that this is not the entire cause of such failures, but it holds true generally in that type of joint which is made by filling nearly full with asphalt the three or four transverse joints and then sweeping over these joints with the grout. The result of this method of construction is well illustrated in one of the accompanying views which illustrates the conditions that obtain not only when the joints are filled with asphalt first, but when they are purposely left empty while the rest of the pavement is being grouted and then filled later with the expansion material. Concentration of pressures under condition of expansion is invariably the result of this method of construction. In some cases the irregularity of the brick causes actual contact between them, or a hard pebble may drop into the joint and become wedged, producing the same effect on a small enough area to exceed the compressive strength of the brick. Hence the brick at such a point spall off or crush badly. This type of joint, happily, is going out of use.

But beyond this pure surface spalling due to only a partial filling of the joints, "blow ups" are frequently traceable to the same class of faulty workmanship. It may be readily seen that the concentration of the pressures on the upper half of the brick surface produces, in effect, a toggle joint which, when the pressures have reached a sufficient magnitude, will inevitably result in an upheaval of the surface. While it is recognized that incompletely filled joints are not the prime and only cause of such failures, it has been observed that "blow ups" frequently occur at places where the grout has not penetrated for the full depth of the brick.

Spalled Joints in Concrete Pavements

The same theory of concentration of pressures can frequently explain spalled joints in concrete pavements. Careless construction may result in the joint being set from ¼ in. to ½ in. or even more below the intended surface of the pavement. In this case, of course, the concrete when laid extends over the expansion material and the stresses set up by an expansion of the pavement concentrate in this thin layer. The condition following such faulty construction is illustrated in one of the accompanying illustrations and the amount that will spall off will depend a great deal upon the depth of concrete over the joint.

Engineers very frequently forget that a pavement is not a fixed structure but is continually changing its volume. While the expansive forces due to the increase in volume may not be very great, in any pavement which is of the rigid type it is necessary to take them into account. Of the two recognized methods of doing this, one is to design the pavement slabs strong enough to withstand the temperature stresses, and the other provides amply for the expansion by means of joints spaced appropriately and constructed of such materials as to allow of compression when the pavement has a tendency to increase in volume.

That the variable density of the sand cushion in certain kinds of foundations at the time of construction may later cause "hollows" under the brick is recognized and known as a source of trouble. The importance of a good foundation or support under a brick pavement should not be discredited. This article is not intended to lessen the importance of the foundation, but rather to explain an additional cause for a certain class of defects in construction which may be the sole cause of trouble that is too frequently attributed to the use of poor materials.

In addition, if defective grouting occurs over a place in the foundation which offers little support to the brick, failure will inevitably occur at this point, and while either the defective foundation or defective grouting would have been sufficient in itself to cause failure under heavy traffic, the two defects occurring at the same place are certain to cause failure.

If engineers are acquainted with the theory upon which such failures as mentioned above are based, they will be more on guard against the defects in the original construction of the surface which may lead to such failure, and it is with hope that attention may be focused upon this question that the above matter is presented for consideration.

Victoria Engineers Hold Annual Meeting

THE annual meeting of the Victoria branch, Canadian Society of Civil Engineers, was held in the club room, 610 Belmont House, Victoria, B.C., on Wednesday evening, Dec. 12, and the following officers were elected for the ensuing year: Chairman, R. W. Macintyre; vice-chairman, R. Fowler; secretary, E. G. Marriott, 610 Belmont House, Victoria, B.C.; treasurer, E. Davis; to complete executive, W. K. Gwyer and E. P. McKie; auditors, F. C. Green and C. Hoard.

A financial statement for the current year was presented by the auditors, Messrs. J. B. Shaw and L. W. Toms, showing that the branch finances were in a satisfactory condition. The executive committee reported that that they had invested the sum of $100 in a Victory Loan bond on behalf of the branch and also that $25 had been forwarded to Montreal for the tobacco fund for members serving overseas. It was unanimously resolved that a further sum of $25 should be donated to the Widows' and Orphans' Fund of the overseas members who have given their lives for the Empire.

A hearty vote of thanks was moved to the retiring chairman Mr. D. O. Lewis, for his useful and energetic work in connection with the reorganization of the society and the affairs of the branch locally.

Preparing Rock Products

Essential Elements of Sand and Gravel or Crushed Rock Plants—Proper Combination of Materials for Good Results

SAND and gravel or crushed rock plants just a few years ago consisted of a combination of individual ideas, local practice, market requirements, theories, some engineering, common sense and errors. Local practice in many localities was satisfied with the use of bank run or crusher varieties of concrete materials, with no particular care taken regarding percentage of voids, gradations or foreign matter. At the present time, perhaps fully half of the gravel pits operating market their gravel just as it runs from the bank, all combined together from 1½ in. stone to ¼ in. pebbles, some of it washed, but without any regard to the amount of each size, just so it is gravel with the sand taken out.

In a paper read before the Western Society of Engineers, R. W. Dull, of the Raymond W. Dull Co., Chicago, gives his views regarding proper methods to use in the preparation of these rock products, with particular reference to washing and sizing:

Denser Gravel Makes Cheaper Concrete

It has been demonstrated that materials assembled together in such proportions as to form the densest mass make the cheapest and strongest concrete. This, then, calls for the producer to grade his gravel into several sizes. The materials can then be re-combined to approximate the densest mass. Since the dollar and cents argument is usually the most impressive, we wish to give Taylor and Thompson as an authority on mixtures with different percentages of voids, to show the folly of using the 1½ in. to ¼ in. gravel as it comes from the bank or river, even if it is washed. Materials handled in this manner will vary from 30 per cent. to 50 per cent. of voids.

Assuming a mixture of 1:2½:5, an approximate delivered cost per bbl. of cement of $1.70, sand at $1.00 and stone of $1.70 per yard, the total cost for material to make one cubic yard of concrete with stone or gravel having 50 per cent. voids is $4.34; with 40 per cent. voids $4.02, and with 30 per cent. voids $3.68, a saving surely worth consideration.

Assuming then that it is desirable to grade the stone or gravel into several different sizes to recombine into the densest mass, we will discuss the best practice to make this separation. The general practice in coal screening, and in fact all dry screening processes is to take out the fine materials first. This method retards the screening efficiency because the large pieces of material cover to a great degree the openings in the screen and hinder the smaller particles from passing through. With the use of water and individual screens it is possible to take out the largest particles first.

Remove Large Materials First

Greater screening efficiency is obtained in this manner because when the first separation is made we have the greatest quantity to screen and with the large size holes the material will more readily pass through the large holes than through the small holes and when we have screened down to the smallest sizes, which are more difficult to screen, we have to screen only a small percentage of the material we had at the start of the process.

We also find with this latter system that the finer screens, which are more delicate, are not subject to as much wear since they are relieved of the large stone.

A few years ago the writer was confronted with the problem of designing gravel washing equipment and undertook to develop machinery best suited for the purpose. Engineers had given the matter very little attention and the gravel pit owners were either compelled to develop their own machinery or to use equipment on the market very poorly adapted for the purpose. Shaker screens designed for coal screening or cylinder screens made for stone crushing were used principally.

Inclined Conical Screens

Our final development of screens was the inclined conical screens, all mounted on an inclined shaft. Our reason for designing the screens in this manner was to simplify the driving machinery for the individual screen arrangement. To install separate driving mechanism with the consequent wear was the first thing to avoid. The second condition was to give the inclination of the screening surface the best working angle, and the third condition to give the water pans for fluming from screen to screen the minimum possible slope and still carry the solids by the washing water. The last condition was necessary to keep the height of plant as low as possible and cheapen the cost of raising the material to the top of the plant.

This set of screens has the simple drive. Only a pair of gears and a countershaft constitute the drive connections for all the screens. The lower portion of the screens has the best screening inclination, which is 1½ in. per foot. The water pans have a minimum slope of 2½ ins. per foot. So we have the three fundamental conditions all fulfilled in a remarkably simple manner. The bulk of the water is introduced at the large end of the first screen, which takes out the coarsest material, which passes out the small end of the screen.

The material which passes through the screen is carried by the water in the water-pan below the screen into the second screen when a second size somewhat smaller than the first size is taken out by the second screen in the same manner as the first size is obtained. This process is continued through the series of screen until all the gravel is removed. We now have remaining the muddy water and scoured sand which is separated by the sand separator.

Scrubbing

Many materials do not always readily become clean without preliminary scrubbing. We found it advisable to devise something to agitate the materials and scour the stone to a considerable extent before going into the washing screens.

The scrubber consists of a large cylinder mounted on the extension of the screen shaft axis and driven by the same gears. The cylinder is divided by internal rings which retain the material and water in the compartments and the lifting vanes agitate and scour the mass similar to the action of a concrete mixer. The mass overflows from one compartment to the next and after passing through the four stages, the preliminary work is accomplished.

In addition to the water first introduced we arrange several jets, at the small ends of each screen, which flow in opposite direction to the travel of the material.

These jets wash off this muddy water, sand and other particles which cling to the stone.

Sand Separators

The most of the power operated devices for the separation of the sand from the muddy water which were in use for this work would not last very long. We made some extensive experiments to determine the best method of extraction of the sand. If the sand and water were run off together the water would soak through the sand and leave the mud in the sand similar to a filter bed. By inverting this method and drawing oft the water at the top and with it the impurities held in suspension, and the sand below, we were able to obtain the desired results.

Our experiments determined that a conical shaped tank suspended on scale beam levers was the most efficient device. The scale beam levers have knife edges and are almost as sensitive as any scale. The cone valve at the lower point of the tank is connected with the counterweight lever and an upward motion of the counterweight lowers the cone valve. If, then, sufficient sand accumulates or settles in the tank to cause the counterweight to rise, the cone valve drops and a sufficient amount of sand escapes from the tank to the bins below until the tank is relieved of the excess weight and the valve is automatically closed. The discharge is intermittent and there is a sufficient quantity of sand in the tank at all times to make a sand seal to prevent the water from going through with the sand.

Bin Construction

Some of the earlier plants which we designed used the cribbed construction. We found that the life of the bins was short because the water would be held in the cracks between the planks and the wood would decay rapidly.

We then adopted a construction which did not have this fault, was more accessible for the replacement of timbers and provided means to perpetuate the life of the bins.

Methods Used for Excavating Materials

Quite a variety of methods are used for excavating the material. One reason is that pit owners are often contractors who have purchased steam shovels or locomotive cranes and wish to use them rather than buy special equipment. The physical condition also is a great deciding factor on the best method for excavating, and another deciding factor is the capacity of the plant.

In some localities the material is taken from a river and calls for a cableway of 1,000 or even 1,500 ft. span. Some of these cableways have travelling towers and others pivot about one tower and have the other tower mounted on circular tracks. River work is more or less hazardous due to floods, and unless a floating plant is installed the cableway system is used with towers which are placed on opposite banks.

Another system of excavation which has become very popular where local conditions will permit, is the slack line cableway excavator. These systems will operate very efficiently over a span of 500 feet but we do not recommend them for a greater span. This system operates much faster than the other style of cableway.

This style of excavator is installed with a main tower or mast at one end and an anchorage of some sort at the ground level at the other end. The bucket is suspended from a trolley which runs on the main track line. The machine is operated by a two drum hoist. The main cable is raised and lowered by means of a block and fall arrangement, the cable from which leads to one of the drums of the hoist. Another cable called the load or drag line is attached to the bucket and leads to the other drum on the hoist.

In operating the bucket runs down the inclined main track line by releasing the clutch on the drum and controlling the drum by the brake. The descent of the bucket is very rapid, and it only requires about ten seconds to travel the 500 feet. When the bucket reaches the digging point the main track line is lowered until the bucket rests on the material. The bucket is loaded by pulling forward and when full the main track line is raised and the bucket is brought to the dumping point.

Belt Conveyor Systems and Field-Conveyors

The usual arrangement for belt conveyors is from a track hopper into which cars dump and from the hopper the material is fed to the belt conveyor which carries it to the top of the plant. The commercial cast iron idler is not very strong and we have developed an idler with a pressed steel pulley for this work.

Another method used for bringing the material from the excavator to the plant is the field conveyor. The way we advocate constructing them is to build the conveyor on a series of sleds. Each sled can then be lined up independently. The advantage of this system is that a continuous flow of material goes to the plant. Better screening results on account of this steady flow through the screens.

Most of the plants are electrically operated with small groups of driving connections for the smaller machines and individual drives for the larger units. Steam-driven plants are also extensively used and a few use oil engines.

The oil engine plants which are near the source of oil supply are able to furnish power cheaper than any other kind of power.

Floating Plants

In dredging from the river many plants are constructed on boats. A complete washing plant for washing and grading and making a finished product delivers to several scows alongside the boat. Each scow receives a different grade and the waste material is run back into the river or lake.

These plants must also be designed to suit many different conditions. In some cases dredge pumps are used and where the material is too hard for pumping orange-peel buckets are used. Dredging elevators are also used for this purpose.

Dredge Operation Delivering to Land Plant

This style of plant, where a portion of the material to be excavated is below water level and is not packed too tight, gives very efficient results. Many installations have gone wrong because they have attempted to pump to the top of the plant, which resulted in excessive power requirements and numerous mechanical and screening difficulties. We recommend pumping to the plant with the pipe line as near horizontal as possible. The material can be dewatered in a concrete sump or basin and the material elevated to the top of the plant by a dredging elevator. Take as an example, a dredge pump usually delivers 10 per cent. solids, and to raise ten tons of water to get one ton of material is not a very efficient process.

Report on Concrete Ships

Adaptability of Concrete Considered by Joint Committee, Who Make Recommendations

JUST at the present time when there is a demand for the addition to our shipping, of a large tonnage in the shortest time, concrete as a possible shipbuilding material has been much in the public eye. The immediate requirements are for seagoing vessels, and while there is not much precedent to warrant the use of concrete for such types of ships, yet certain inherent advantages of concrete, together with the experience derived from the building of concrete barges and lighters, indicate the possibility of making successful application of this material. There are, indeed, in course of construction throughout Canada and the United States a number of sea-going concrete vessels and recently at least one such ship has been put into ocean service in Norway.

With the object of determining to what extent concrete may be depended upon to afford a possible solution of the shipping problem, a join committee from the American Concrete Institute and the Portland Cement Association has been working for some months past with consulting engineers and naval architects. As the available information on the subject is considered rather meagre, the report which has recently been handed down is largely a general statement of the several elemtnts which make up the concrete ship problem, and a discussion of the information obtained from the tentative design of a concrete ship. This design study is based on a 2,000-ton self-propelled barge of a length of 227½ feet, a beam of 42 feet and a loaded draft of 18 feet, at which draft it would have a displacement of 3,675 tons. The report states that the total cost of hull, exclusive of equipment, would be $126,000, or about $63 per ton of dead weight, against a cost of $90 to $120 per ton for a similar steel hull, or $70 to $100 for a wooden hull. The committee points out that, due to the serious effects of wave action in the open sea, there is a radical difference between the design of a barge or ship for ocean trade and a barge for still-water use.

Several points from the committee's report follow:

Relation Between Carrying Capacity and Displacement.—The displacement of a ship is the weight of the water she displaces, and is therefore the sum of the weight of the ship itself and its cargo capacity expressed in tons. The cargo capacity will hereafter be spoken of as the "dead weight."

It is apparent that the efficiency of a ship as a cargo carrier depends upon the relationship between dead weight and displacement. Expressed in terms of per cent., in the average cargo ship built of steel, the dead weight is from 70 to 75 per cent. of the displacement—taking into account as weight of ship all spars, fittings, deck houses, anchors and chains, auxiliary engines and tanks, but not boilers, engines or coal. In a wooden ship, the dead weight is from 60 to 65 per cent. of the displacement. It is quite evident that from the difference in weight of materials, it will be difficult to design a ship of concrete that will give a relationship between dead weight and displacement approaching that of steel. However, if ships are to be built of concrete for commercial use, the weight of the ship must be such as to provide a reasonable dead weight or cargo capacity for the displacement.

Transverse Strength.—The stresses in the transverse members of a ship are, in still water, functions of the draft and the stiffness, and may be computed by mathematical processes, although the computations are long and laborious. When the material is reinforced concrete, the problem becomes much more complicated. Experience has shown, however, that numerous elements other than draft effect the transverse strength of a ship, such as the effect of rolling in a sea way, impact with docks or other ships, and stresses incident to going into dry dock. The transverse members of cargo ships of to-day are, therefore, not designed to withstand computed stresses, but are designed in accordance with various rules which embody the result of long experience in the construction and use of ships. It should be noted in this connection that granting of insurance depends on compliance with these rules.

Steel ships are of two different types, (a) framed ships, in which transverse ribs or frames are spaced from 18 to 24 inches on centers, the plating being riveted to these ribs without intermediate longitudinal members, excepting in the bottom; and (b) longitudinally framed ships (Isherwood), in which heavy frames are spaced from 10 to 15 feet on centers, with intermediate longitudinals to which the plating is riveted.

From a comparison with the ordinary steel ship design, it would appear to be not difficult to design transverse members of reinforced concrete of equivalent strength to steel members—the question of strength only being considered.

Longitudinal Strength.—A ship must be able to meet conditions which are unlike any to which land structures are subject.

In determining the longitudinal strength of a ship, it is customary to assume two conditions. Under the first condition, the ship is assumed to be suspended between two wave crests—the length between crests being equal to the length of the ship between perpendiculars, the height of the wave being equal to one-twentieth of that length. In this case, the ship as a whole is acting as a simple beam supported at the ends. This condition is termed "sagging." Under the second condition, the ship is assumed to be supported amidships on one crest of the same wave. Under this condition, the ship as a whole acts as a cantilever. This condition is termed "hogging." It is apparent, therefore, that when a ship is riding the waves both the deck and the bottom of the ship will be required to withstand tensile and compressive stresses alternately—the maximum tensile stress following the maximum compressive stress at very short intervals. In a steel ship the entire cross-sectional area of the midship section acts to resist these stresses, taking into account, in determining the moment of inertia, all of the continuous members, such as continuous scantlings and deck side and bottom plates. In the concrete ship, equivalent strength must be provided. In the case of the concrete ship, however, only the steel reinforcement can be relied upon to take tensile stresses. The concrete assisted by the steel will take the compressive stresses.

The effect of the rapid change of the character of the stress in either the deck or the bottom is much more serious in the case of a concrete ship than in the steel ship for the reason that, owing to the low tensile stress of concrete, cracks will occur at the extreme fiber under relatively low tensile stresses on the steel. These cracks, if any, alternately opening and closing, may tend to cause disintegration, with resulting leaks or impairment of the reinforcement.

At the present time, little information is available as to the effect of such reversal of stress, and but little can be hoped for until an actual trial has been made of a concrete ship in a sea.

Elasticity.—There is an almost unanimous opinion among naval architects and seafaring men generally that a concrete ship will be so inelastic that she will tear herself to pieces in a sea. While it is doubtless true that in a concrete ship there will not be the same readjustment of stresses as in a steel ship when subject to the action of a heavy sea, experience with reinforced-concrete structures generally has shown that such structures have considerable elasticity and there is ample reason for the hope that reinforced concrete will prove a suitable material for shipbuilding purposes.

Effects of Sea Water on Concrete and Reinforcing Steel.—Until very recently, little information has been available as to the effect of sea water on concrete. The recent work of the Bureau of Standards, acting in co-operation with the Portland Cement Association, has thrown considerable light on what may be expected from the action of sea water. The result of their investigation tends to show that inferior concrete or concrete of which the surface skin has been impaired suffers serious disintegration when in contact with sea water. Inasmuch as in most instances the structures examined, which form the basis of the report of the Bureau of Standards, were built without thought as to the action of sea water (it being assumed that there would be no deleterious action) there is every reason to hope that where the effect of sea water is appreciated, and where steps are taken in the way of selected materials and adequate workmanship, assuring a good mix and a satisfactory surface skin, the concrete will not so deteriorate.

With regard to the effect of sea water on the reinforcing steel, there is some question as to whether a thin layer of concrete can be relied upon to protect the steel from corrosion. To provide a thick protective layer of concrete outside of the reinforcing steel is practically out of the question, owing to the large increase in weight. If the reinforcement, therefore, is to be maintained in perfect condition, the steel must be protected by galvanization and by increasing the efficiency of the protective concrete by means of additional care in material and workmanship and by a surface coating of a waterproofing character.

Relative Cost.—Just at the present time, the demand for tonnage is so great that any ship of reasonable capacity than can be used for carrying cargo will prove financially successful. The relative costs of ships of concrete and steel, or concrete and wood, is not therefore an important consideration as it will be after the war when conditions again approach the normal. However, it is necessary to have an adequate idea of the probable cost of a concrete ship as well as a comparison with the cost of steel and wooden ships.

Speed of Construction.—Speed of construction is of vital importance in the shipbuilding program to-day owing to the immediate requirement for tonnage. If it shall be found that the concrete ship can be constructed in much less time than a steel or wood ship, this fact will contribute largely to the success of the concrete ship.

The conclusions of the report are:

The designs of various other types of ship in which reinforced concrete has been proposed, either alone or in combination with structural steel, were examined by your committee.

Formwork is a Large Item

In some of these designs cellular sides and bottoms are proposed. Although double sides and bottoms in ships have distinct advantages, when the material is concrete, such a design appears out of the question, not only because of the considerable increase in weight, but also because of the added complication to the formwork—already a large item in the cost of a concrete ship.

Designs have been proposed in which structural steel members are used as reinforcement. While such members assist somewhat in maintaining the lines of the ship during the construction of the form work, the added advantages can hardly offset the increased cost due to the fabricated steel work and the inefficient use of the reinforcement.

One design has been proposed in which structural steel members are used to support a shell of reinforced concrete. While the claim is made that a ship can be built of the proposed design with only about one-half of the steel used in a steel ship of the same capacity, and at much greater speed of construction, the difficulty of making the two materials act together, thus avoiding cracks, makes the design as proposed of doubtful value.

Your committee feels that it is not its function at this time to prepare any detailed plans for a concrete vessel. It is manifestly impossible to design a type of vessel that will be applicable to all classes of service. A barge for use on the canals of New York would not be an efficient type for use in harbors or on the Ohio or on the Mississippi.

Vessels heretofore built have demonstrated that the small barge for still-water service can be built and successfully operated. The solution of the larger problem of a concrete ship will include the solution of smaller vessel problem, in which questions of strength are not of the same prominence.

Although there are some questions regarding the concrete ship which can only be answered by actual experiment, the studies which your committee has made point to the commercial success of the concrete ship.

Concrete and Reinforcement Specifications

Your committee suggests that specifications for a concrete vessel should embody the following principles:

1. Both cement and aggregates should be selected with great care to insure a concrete of maximum efficiency.

2. The concrete should be placed in one continuous operation to insure monolithic construction. The concrete mixture should be such as will develop a crushing strength in excess of 3,000 lbs. per square inch when tested in standard cylinders at 28 days. A concrete consisting of one part portland cement, one part sand and two parts ½-inch aggregate may be expected to give such a concrete. The mixture and workmanship must be such as will assure impermeability.

3. The reinforcing steel should be in the form of deformed bars and should be galvanized.

4. In parts of the vessel where cracks in the concrete would tend to cause leaks, the stress in the steel should be kept low (preferably less than 12,000 lbs.).

5. Some form of elastic waterproofing coating should be applied to the hull below the deck.

Practical Hints for the Contractor

that may save him time and money. If you know any labor-saving scheme, send it in—preferably with illustrations. We will pay for all accepted articles.

Travelling Concreting Plant Saves Seventeen Men and $46 per Day

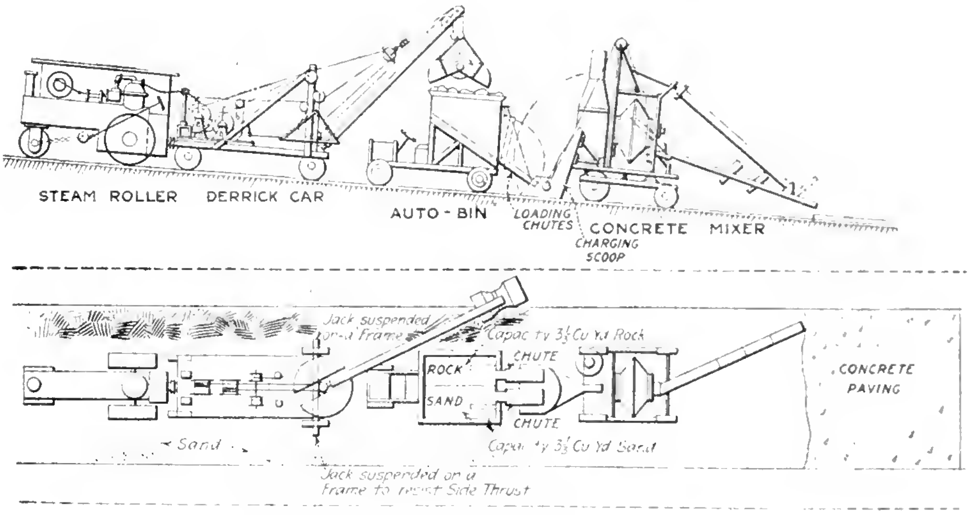
SPECIAL equipment of a travelling concreting plant has been planned in order to eliminate the usual gang of wheelers and shovelers for loading the charging skip of the mixer, and thus reduce the present difficulties of labor shortage. Greater capacity of output is also claimed for this plant. It is designed particularly for concrete road and paving work, or for placing the concrete base for other paving.

At the head of the plant is a steam roller or tractor hauling a light derrick car having a 20-foot boom and ½-yard grab bucket. The roller supplies steam for the derrick hoist. Next to it is a self-propelling bin car for three yards of sand and three yards of stone. Behind the bin car is a self-propelling mixer, preferably of one yard capacity. Stone and sand are piled on opposite sides of the roadbed, leaving a passage for the roller and derrick car. The grab-bucket loads the materials into the bins, which discharge through spouts directly into the charging skip or scoop of the mixer. This skip must be of the box type, and is marked with gauge lines showing the proper depth of charge for the coarse and fine aggregates.

A locomotive crane on traction wheels may take the place of the roller and derrick car, but the roller is a part of the contractor's plant and both roller and derrick are operated by one man. The outfit as first described, is likely, therefore, to entail less expense for new equipment. Ordinarily a three-drum hoist would be required for the derrick, but by means of a special device a two-drum hoist can do the work. The bin car is made a separate unit in order that it may be kept in position to feed the scoop of the mixer.

This concreting outfit and method of working have been devised by O. N. Gardner, Jamestown, N.Y., and is described in Engineering News-Record. He estimates that a crew of only 25 men will be required, as compared with 42 men where the ordinary method of working is employed. Furthermore, he asserts that the charging of the mixer can be done in 90 seconds, as compared with 110 seconds by hand work, so that the output capacity will be increased materially.

For the force and wages given, with 30 cents per hour for common labor, the daily cost for labor would be $85.50 per day for the mechanical system and $131.50 for the hand system, or a saving of $46 per day. The figures are based on a mixer with drum holding 1 cubic yard of unmixed material and a 4-bag batch of 1:1½:3 concrete. The volume of loose material in the charging skip would be four cubic feet of cement, six of sand and 12 of stone, or 22 cubic feet. The batch of mixed concrete would have a volume of about 14.66 cubic feet. With 40 batches per hour the concrete placed would be 217½ cubic yards per 10-hour day. But with the slower charging of the mixer by the hand system there would be only about 320 batches and a smaller output.



Labor saved with this road or street concreting outfit.

Steam Thaws Frozen Trench at Cost of Nine Cents per Foot

TO thaw earth that is frozen to a depth of 2 ft. or more is a problem that often confronts a waterworks superintendent. Edgar S. Smith, superintendent of the Water Department of Pocatello, Idaho, solved the problem in a simple manner and at a cost of less than 10 cents per foot of trench for thawing. The method is described in Engineering and Contracting.

The ground was frozen 4½ ft. deep and in 24 hours was completely thawed to a depth of 2½ feet. The remaining 2 feet were softened sufficiently to be easily picked. The method of thawing consisted in laying a double line of 1½-inch pipe over the trench and covering it with fine sand. Steam was fed into the pipe from a traction engine boiler, and a block 300 feet long was thawed at one setting of the engine. It took about two hours to shift to the next block, haul the sand and cover up the pipe, using two men and two teams.

The backfill material must either be thawed or manure must be laid over the water pipe before backfilling with frozen earth.

Better Government of Montreal

A scheme for the better government of Montreal has been discussed by the members of the Montreal Builders' Exchange. Various plans were looked into by the directors, who came to the conclusion that the one outlined by the Chambre de Commerce was the best, taking it as a whole. This recommends the election of a mayor and 25 aldermen; five of the latter are to be elected by the proprietors at large, and will form the finance committee, while the other 20 are to be elected by the general body of voters. At a special general meeting of the members of the exchange the plan was approved. At the same meeting the nomination committee to select the officers for 1918 was appointed.

Changes in Montreal Engineering Staff

Following the appointment of Mr. G. R. McLeod, head of the sewers department of Montreal, as a member of the staff of the Imperial Munitions Board at Washington, certain changes in the city of Montreal engineering staff are proposed. Mr. Mercier, the chief engineer, recommends the appointment of Mr. E. Fusey, assistant engineer for the north division of the sewer department, as superintendent of the sewer department; Mr. Henri Valiquette, engineer of the west division of the city, as superintendent of tramways traffic; and Mr. Lanctot, assistant engineer, as successor to Mr. Fusey, as superintendent of the north division of the sewer department.

Ottawa Branch C. S. C. E.

Lieut.-Col. C. N. Monsarrat, M.Can.Soc.C.E., chief engineer and chairman of the Quebec Bridge Commission, addressed the Ottawa Branch of the Canadian Society of Civil Engineers on December 20 on "The Quebec Bridge." His paper dealt with all the important features of the work, including construction of caissons, sinking of piers, erection of superstructure and floating and lifting of centre span. Slides and moving pictures illustrated the address.

"Cement and Its Commercial Uses"

"Cement and Its Commercial Uses," was the subject of a talk by Mr. J. F. Rhodes, publicity manager of the Canada Cement Company, at a meeting of the "Kiwanis" Club, Montreal, on December 13. Mr. Rhodes referred to the importance of good roads, particularly in relation to the transportation facilities for farmers, thus enabling prices to be reduced to the consumer. He also outlined the many uses to which concrete is put, such as the building of ships, sewerage systems, national highways, water supplies, and buildings of all descriptions. Mr. Rhodes suggested that the back alleys of Montreal should be cleaned up and laid in concrete, which would help to eliminate disease, thereby reducing infant mortality.

Saskatchewan Branch C. S. C. E.

The Saskatchewan Branch of the Canadian Society of Civil Engineers held their monthly meeting on December 13 at the Assiniboia Club in connection with their regular dinner. An illustrated paper read by Mr. E. A. Markham, on "The Sanitarium at Fort Qu'Appelle," was an interesting feature of the evening.

Mainly Constructional

East and West—From Coast to Coast

Lord Shaughnessy, K.C.V.O., has been elected an honorary member of the Canadian Society of Civil Engineers.

General Mewburn states that the military authorities are going to build 4,000 huts on the militia property in Halifax to house the homeless.

The John Coughlan & Sons shipbuilding plant at False Creek, Vancouver, is to be extended and improved, according to a recent announcement.

Under the Winding-up Act, the property of the Ontario National Brick Company at Cooksville, Ont., is to be sold by public auction on January 22. This includes shale and clay deposits, brick plant, various office and factory equipment, etc.

On behalf of a number of citizens, Mr. J. J. McKay recently petitioned the works committee of Hamilton, Ont., that 50-foot roadways be constructed instead of 66-foot as at present. The committee said it had no power to effect any change in this regard.

A by-law will be submitted to the ratepayers of Midland, Ont., on January 7 to authorize the town council to grant a portion of the Fraser Park as a site for a memorial hospital to fallen soldiers. This is to be known as the Midland General and Marine Hospital.

At their recent meeting the directors of the Steel Company of Canada declared the usual dividends. It was stated that the company's orders were as large as they had ever been, and that the outlook was excellent. The company has been particularly fortunate in its relations with its employees and there has been practically no friction.

Capt. Symons, advisory architect to the military hospitals commission, has recommended that work be commenced immediately on the construction of three pavilions for the Balfour military sanitarium at Nelson, B.C. The new pavilions would accommodate an additional sixty patients and the cost is estimated at about $24,000.

The proposal to erect a military hospital in High Park, Toronto, has apparently been dropped, at least temporarily, owing to some hitch at Ottawa, it appears. The Military Hospital Commission, it is stated, are now opposed to spending $300,000 on buildings in High Park that will only be available for a few years. In the meantime the construction work is held up.

The Board of Works of New Westminster, B.C., is replacing certain portions of a sewer laid in 1912. It gave out over a distance of two blocks, and when uncovered it was found in some places to be completely disintegrated, while other lengths were in quite good condition. The method of operation is to take up and replace about thirty or forty feet at a time, bridging the gap by pumping. Previously, in 1913 a part of it had to be replaced.

The Queen Alexandra School annex in Toronto will cost some $30,000 more than was originally estimated. The tenders were as follows: Masonry, $38,500; carpentering, $24,000; heating, plumbing, etc., $21,098; ornamental iron work, $5,295; plastering, $4,950; painting and glazing, $2,943; reinforced concrete, $2,147; marble work, flooring, $1,956; galvanized iron work, $1,345; temperature regulation, $1,183; electrical work, $897. The original estimate was $70,000, so that the increase in cost is over 40 per cent.

The city of Quebec will apply to the provincial legislature to obtain certain amendments to its charter of incorporation and to be authorized to borrow the sum of $486,568.44 to meet debentures maturing in January, 1918. Provision will also be made for the extension of Chateuguay St.; the construction of permanent sidewalks; subscription to erect a monument to Sir George Etienne Cartier; modifications of the law concerning the maintenance of roads running alongside the city limits; modifications of the law concerning the construction of buildings.

The tender of Messrs. Mundy & Stewart, Toronto, with respect to the Kapuskasing River pulp and timber limit, has been accepted by the Ontario Government. The agreement provides that the successful tenderer shall erect, within the limits of the territory in question or at some other point approved by the Lieutenant-Governor in Council, a plant costing not less than one million dollars. The daily output is to be not less than one hundred tons of pulp and on an average at least 200 hands are to be employed for not less than ten months of the year.

The city of Toronto is the defendant in action for $10,000 damages on account of odor nuisance in connection with the Morley Avenue sewage disposal plant. Sir William Mulock, the trial judge, suggested that the sewage could be pumped to some suitable site far outside the city limits. Commissioner Harris, the first witness examined, objected to the enormous cost of such a scheme. He stated that he is recommending an experiment with the activated sludge method of sewage treatment. The city called Col. Nasmith, of Toronto, and Mr. T. C. Hatton, of Milwaukee, as expert witnesses.

The value of building permits issued in the city of Quebec during the month of November reaches an unusually large figure. The number of permits is twenty-five and their value $493,840. Two large undertakings are included. One is the reconstruction of the Limoilou Church at a cost of $150,000, and another, the enlargement of shed B of the Quebec Harbor Commission at the Louise Embankment at a cost of $325,000. Work has been commenced on the latter project and according to the terms of the contract, the shed must be completed by September 1, 1918. It will be constructed entirely of steel and concrete and when finished will measure 300 x 90 feet.

Rapid progress has been made on the big shed on pier No. 2 at Ogden Point, Victoria, B.C., and it will probably be complete at the beginning of the year. The building measures 700 ft. by 200 ft. and will be the largest and best equipped waterfront warehouse on the Pacific Coast. The purpose for which it is now intended is for the assembly of machinery in the wooden steamships being built for the Imperial Munitions Board on the B. C. coast. As the hulls are launched they will be towed to Ogden Point and equipped with power. Grant, Smith & Co., & McDonell, contractors for the Dominion Government piers at Victoria, are handling the warehouse contract.

A report has been submitted by Thomas Adams, town planning expert of the Conservation Commission, to the Board of Control at Halifax regarding the reconstruction of the devastated area in that city. The report went into considerable details showing the magnitude of the problem with which Halifax is confronted. After some discussion the Board decided to request Premier Murray to call representatives of the City Council, the Board of Trade, the Provincial Government, the Federal Government, the Executive of the Relief Committee, the Town Planning Board and the naval and military authorities, with a view to having a permanent commission appointed to deal with all matters pertaining to the rebuilding of the destroyed portion of the city, and with all problems which are the outcome of the recent disaster.

According to the annual report of the Quebec Minister of Highways the province now has 2,238 miles of macadamized or gravel roads. The Highways Department has given instructions for the repair of macadam or gravel roads to 183 municipalities, of which 94 have done the work, and to six cities. Some 200 inspections of the work have been made. A system of caretakers for the maintenance of the main highways has been adopted. Thirteen miles of asphalt surfacing has been laid on the Montreal-Quebec road and four miles on the Chambly road, between St. Hubert Station and the town of Longueuil. Bad weather has prevented more than this being done, but the department has distributed materials over nineteen and a half miles, leaving it ready for the work to be completed in the spring. It is probable that similar surfacing will be laid on the rest of the Montreal-Quebec highway.

Obituary

Mr. John Taylor, founder of the firm of Taylor and Arnold, Ltd., Montreal, general railway supplies, died at his residence in Westmount, after a long illness.

Mr. Joseph Hobson, one of the most eminent engineers in the Dominion, died recently at his home in Hamilton at the age of 84 years. Born near Guelph, Ont., in 1833, he received his education for his profession in Toronto, and while a young man joined the firm of Gzowski & McPherson, who built the G. T. R. between Toronto and Guelph. In 1870 he succeeded Sir John Kennedy as chief engineer of the Great Western Railway, and when that company amalgamated with the G. T. R., he was chosen as chief engineer of the Grand Trunk lines west of Toronto. In that capacity he had charge of the construction of the international bridge from Buffalo to Fort Erie and the replacement of the old Suspension Bridge below Niagara Falls. For ten years he held the position of chief engineer of the Grand Trunk, from 1896 to 1907, since which latter date he had been consulting engineer. The late Mr. Hobson was more eminent in his profession than Canadians generally realized. In his career two great achievements stand out for which his name will long be remembered—the railway tunnel under the St. Clair River, near Sarnia, and the rebuilt Victoria bridge over the St. Lawrence River. In the construction of the Sarnia Tunnel, he created a precedent by the use of "shields," which, under hydraulic pressure, greatly expedited the work. His second great achievement, the rebuilding and widening of the Montreal bridge, was particularly notable on account of the fact that the work had to be carried out without interrupting traffic. Mr. Hobson was a member and past director of the Institute of Civil Engineers and also a member of the Canadian and American societies. One of his sons who survives him, is Robert Hobson, president of the Steel Company of Canada.